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ABSTRACT

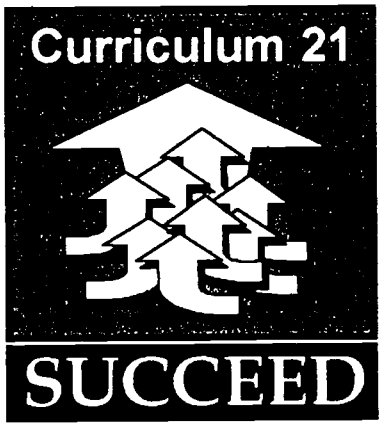
This document contains the annual report for Year 6 of the Southeastern University and College Coalition for Engineering Education (SUCCEED). It features an Executive Summary, a response to recommendations of prior review teams, a description of major accomplishments, future plans, an evaluation, and reports on dissemination, industrial involvement, evidence of culture changes, infrastructure, value added by the coalition, and the program budget. Enrollment and degree statistics, and curriculum profiles of individual schools are also included. Project SUCCEED members include Clemson University, Florida A&M University, Florida State University, Georgia Institute of Technology, North Carolina A&T State University, North Carolina State University, University of Florida, University of North Carolina at Charlotte, and Virginia Polytechnic Institute and State University. (WRM)

SUCCEED

SOUTHEASTERN UNIVERSITY AND COLLEGE COALITION FOR ENGINEERING EDUCATION

Annual Report Year 6

June 1998



An NSF Engineering Education Coalition

Clemson University - Florida A&M University - Florida State University
Georgia Institute of Technology - North Carolina A&T State University
North Carolina State University - University of Florida
University of North Carolina at Charlotte
Virginia Polytechnic Institute and State University

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A. Executive Summary

SUCCEED's mission in its second five years of operation is to institutionalize its curriculum model and disseminate it beyond the Coalition. The curriculum model is designed to impact student learning through early and explicit skill development, early introduction to engineering, enhanced engineering practice content, improved integration of subject material, multidisciplinary design experiences, deployment of technology, and continual assessment and feedback. Many **SUCCEED** programs impact students directly and an emphasis has been placed on scale-up of the proven approaches. A key **SUCCEED** strategy is a sustainable change in the faculty and curricula of our institutions that is expected to have a lasting impact. A wide variety of faculty interaction has been achieved, ranging from single-campus faculty tutorials to larger workshops to national forums with sessions led by **SUCCEED** participants. Estimates indicate that over 1500 faculty and apprentice faculty have been impacted by these programs (exact figures are not yet available because some faculty have attended more than one of the events).

The effect of delays primarily due to the startup of a new contract and moving the headquarters was minimal. The willingness of **SUCCEED**'s member institutions to support **SUCCEED** activities in good faith is a clear indication that there is sufficient commitment to achieve institutionalization beyond the terms of the present award. The External Advisory Board (EAB) was restructured to align external expertise with our four focus areas. This approach has increased the level of interaction between the EAB and **SUCCEED** leadership. As shown in section K, Budget Information, the matching promised is already well in excess of dollar-for-dollar. Significant leveraging by industry, foundation, and college sources is noted in both section G, Industrial Involvement, and section H, Evidence of Culture Changes. The use of videoconferencing equipment by the Guidance Team and other **SUCCEED** teams has improved the management of the Coalition.

The Council of Schools concept appears to be effective in disseminating the broader vision of our curriculum model and has been assisted by the Action Agenda program. **SUCCEED** has assumed a leadership role in the Coalitions program and in the developing engineering education community. Details are provided in section J, Value Added By the Coalition.

B. Response to Recommendations of Prior Review Teams

Three sets of recommendations will be addressed. The review report from **SUCCEED**'s renewal review (December 11-13, 1996), while overwhelmingly positive, had a few recommendations that are addressed. In addition to these, recommendations from **SUCCEED**'s External Advisory Board (EAB) and Deans Council are also addressed.

Review Team: "**[SUCCEED]** is still seriously challenged to establish the necessary standards and metrics required to determine the success of the Coalition program." "...provide technical assistance to project leaders in developing methods to collect systematic ... feedback or to evaluation the outcomes of their efforts." "...lacks clarity about the levels, responsible parties, and steps of strategic planning..." "...the choice of evaluation instruments or specific questions should follow...the goal-setting activity."

Response to Review Team: SUCCEED's Assessment and Evaluation team has accepted responsibility for establishing metrics and providing assistance to project leaders. This is addressed in section E, Evaluation. The Coalition's use of total quality management software for strategic and tactical planning has improved both our planning process and accountability. Team leaders are responsible for their components and the administration is responsible for the planning as a whole.

EAB: "...include ... representatives from other academic departments, potential employers, students, high school counselors ... [as] a focus of **SUCCEED**'s publicity ... and ... included in ... workshops and information sharing sessions." "...assess existing programs and resources ... before implementing new processes."

Response to EAB: We will invite science and mathematics faculty to our workshops. Potential employers are already engaged—refer to section G, Industrial Involvement. Using our longitudinal database, we plan to revisit the projects of the first five years to more accurately assess those efforts.

Deans Council: "SUCCEED efforts [in TBCD] should raise the level of all schools. WWW & ALN can reach many more faculty." "Have each **CIT** establish benchmarks based on common goals." "Form an Executive Council and share plan with Deans." "Review list of schools to which we are disseminating information."

Response to Deans Council: The local **CIT** plans for activity in TBCD and the TBCD **CFT** plans have been modified for Year 7 and beyond to incorporate more basic WWW and ALN activities. Common metrics are being developed by the A&E **CST**. Data will be collected across the Coalition as well as for individual **CIT**s. We prefer to not develop another layer of administration. As needed, small subcommittees will be developed and disbanded to simplify the decision process. We are adding Council of school members on a case-by-case basis. Additional outreach is being done through our inter-Coalition activities. San Jose State University has agreed to join and Michigan Technology University has been invited.

C. Major Accomplishments

SUCCEED has a wide range of accomplishments to report by all its functional teams. These accomplishments include the development of tangible items, changes on the **SUCCEED** campuses that will support educational innovation, significant steps in program assessment, and others. While our accomplishments are distributed across our campuses, here they are organized by type, beginning with highlights of some truly stellar accomplishments, and ending with a special infrastructure accomplishments section.

Highlights

NC State's Introduction to Engineering course will be offered to all incoming freshmen in Fall 1998. The course includes aspects of three **SUCCEED** pilot projects.

Virginia Tech's Camera Dissection laboratory was offered to all 1200 freshmen enrolled in Introduction to Engineering II.

A catalog of 80+ two page **SUCCEED** project summaries has been compiled. This is being entered on the Web and set the standard for a similar archive for all the Coalitions.

Using 1989 as base year percentage increase (corrected for changes in total enrollment) in ethnic minority enrollment for **SUCCEED** institutions was 50% in 1996-97 compared to all other US Engineering Schools at 35%. Percent of engineering degrees awarded to minority students of total degrees awarded in 1997 was 17% for **SUCCEED** institutions compared to the 10% for all other US Engineering Schools.

The **SUCCEED**-sponsored Visualizations in Materials Science CD-ROM has been adopted for use by 65 institutions, reaching more than 10,000 students.

North Carolina A&T hosted two very successful events: the Women's Engineering Board conference last fall and the best practices in outcomes assessment workshop in April.

UF's Integrated Product and Process Design multidisciplinary capstone design program was scaled up to 29 projects, determining the optimum size to be 25 projects.

Some 21,000 copies of the "Mars Navigator," an interactive CD-ROM developed at Georgia Tech in collaboration with NASA JPL to supplement high school science education, have been distributed throughout the world.

UNC-Charlotte's ENGR 1201 was aired on Cable Channel 22 to Mecklenburg County, with six student teams doing presentations on their multidisciplinary team project.

A Virginia Tech mentoring program for under-represented freshman students in engineering provided peer mentoring for approximately 300 Black, Hispanic, and women students during their first semester as engineering students.

FAMU-FSU will offer a First Year Engineering course for the first time in Fall 1998.

The Quality Improvement Partnerships (QIP) course and internship program pioneered by **SUCCEED** is being offered at four **SUCCEED** institutions and Duke University with its text and other course and video tape materials being used at several other schools.

The Multimedia Statics Program, sponsored by **SUCCEED** in its first five years, was requested in Year 6 by over 30 faculty members from the USA and foreign countries.

Clemson, following a November workshop on the subject, has decided to pursue an integrated freshman curriculum.

Workshops, conferences, and seminars

It has always been clear that the funding the NSF provides to **SUCCEED** is a catalyst—that NSF funding alone will not provide sufficient resources to cause the desired reform. As a result, many of our PIs from the first five years and those who are currently engaged on **SUCCEED** teams can be found devoting considerable amounts of their time spreading our vision and innovations and learning about the innovations of others. The table below lists as concisely as possible the wide variety of ways we are nourishing and sharing our vision both with colleagues at **SUCCEED** institutions and with other engineering educators. These are in generally in chronological order, including some future dates. Note that the North Carolina campuses are often used for Coalition-wide events to minimize travel costs.

Event description	Date of event	Location	Number attending	Attendee population
Distance Teaching and Engineering Entrepreneurs	1/31/97	Va Tech	50	Local seminar
Teaching workshop	2/3/97	Va Tech	9	New faculty
Product and process lab and Freshman Rhetoric	3/14/97	Va Tech	13	Local seminar
Design-oriented and Student transitioning activities	3/20-21/97	Va Tech	17	Local seminar
Active Learning with Multimedia	4/4/97	Va Tech	20	Engr. Coll. advisory board
NSF Engineering Education Innovators Conference	4/7-8/97	Washington DC	35	**SUCCEED** delegation
Effective Teaching workshop	4/18-19/97	Va Tech	37	Local campus
Curriculum Innovation and Renewal	4/25/97	Va Tech	20	Local Seminar
A Multimedia Learning Environment in Statics	4/30/97	Va Tech	45	Local ESM seminar
ASEE Annual Conference and Exhibition	6/15-18/97	Milwaukee, WI		**SUCCEED** delegation
SUCCEED Curriculum Innovation and Renewal	8/14/97	NC State		ECE Dept. retreat

Event description	Date of event	Location	Number attending	Attendee population
Effective Teaching	8/97	NC State	21	Local campus
Changing the Culture in Engineering Education	8/20/97	Va Tech	33	Engr. Coll. Retreat
Teaching / Advising / Diversity Workshop		Va Tech	25	Faculty / advisors
Women's Engineering Board Conference	9/97	NC A&T	100	Faculty, students, industry
ABET/ASEE Outcomes Assessment for Eng. Ed.	9/19-20/97	Washington DC	23	**SUCCEED** delegation
Instructional Technology '97 Conference	9/19/97	Va Tech	300	Keynote address by S. Holzer
Multidisciplinary Design	9/19/97	Va Tech	25	Inst. Tech '97
Effective Teaching	10/2-3/97	Ga Tech	57	**SUCCEED**
Active Learning seminar	10/6-7/97	Clemson	39	Local campus
Council of Schools visit	10/15/97	UT Knoxville	20	UT Knoxville faculty
Freshman Curriculum	11/10/97	Clemson	20	Local campus
Multimedia Learning Environments	12/8/97	Va Tech	20	CC transfer conference
Orientation to Teaching	2/11/98	Va Tech	8	New faculty
SUCCEED initiatives	4/10/98	UF	15	Department Chair's mtg.
Asynchronous Learning	2/3/98	Clemson	57	Local campus
Student Success workshop	2/12-13/98	UNC-C	43	**SUCCEED**/COS
SUCCEED activities	3/25/98	UF	20	Advisory Council
Multimedia statics	2/23/98	Va Tech		U. Strathclyde Faculty
Teaching and Learning Online - ALN presentation	4/4/98	UF	20	Local campus
Multidisciplinary Design workshop	3/25/98	UNC Charlotte	45	**SUCCEED** / COS
SUCCEED Annual Conference	3/26-27/98	UNC Charlotte	120	**SUCCEED** / COS / Industry
Outcomes assessment planning workshop		Va Tech		Degree program representatives
Orientation to Teaching	4/3/98	NC State	102	**SUCCEED** / COS
Eff. Teaching trainer wkshp.	4/4/98	NC State	19	**SUCCEED**
Outcomes assessment instruments and processes	4/17/98	NC A&T	45	**SUCCEED** / COS
Wkplace. Transition wkshp.		Va Tech	50	Seniors
Articulation Conference	4/98	Va Tech	40	Transfer students
WWW for Engineering Ed	5/10-13/98	Torino, Italy		Cont. Eng. Ed. Conf.
Mentoring junior faculty	5/12/98	Ga Tech		Senior faculty
Capitol Hill Exhibit (CNSF)	5/20/98	Wash. DC		Exhibit
Using Web Templates	5/98	FAMU-FSU		Local campus
New Faculty Development	5/98	FAMU-FSU		Local campus
Faculty Development on the Shoulders of Giants	6/1998	FAMU-FSU		Local campus
National Effective Teaching Institute	6/25-27/98	Seattle, WA	50	US Faculty
ASEE Annual Conference and Exhibition	6/28-7/1/98	Seattle, WA		**SUCCEED** delegation

Event description	Date of event	Location	Number attending	Attendee population
Internet-use for instruction	Summer 98	Va Tech		Local workshop
Teaching workshop	7/98	UF		CE faculty
Authoring with Director	7/98			**SUCCEED** / COS
Real Audio on the WWW	8/98			**SUCCEED** / COS
Reunion FD Workshop	8/98	NC State		Local campus
Best practices in assessment	Fall 98	Wash. DC		**SUCCEED** / COS
Best Practices in Curriculum Innovation and Renewal	2/99	Orlando / UCF		**SUCCEED** / COS
Multi-Coalition Faculty Development Conference	4/6-7/1999	NC State		All Coalitions
SUCCEED 1999 Annual Conference	4/7-9/99	NC State	150 + estimated	**SUCCEED** + COS + invited
ASEE SE section conf.	4/1999	Clemson		Regional conf.
NSF/NTU downlink	assorted	Clemson	40	Faculty forums
Assessment planning	assorted	Clemson		Local faculty
Assessment Seminar	assorted	Ga Tech		Acad. coordinators
FD workshop series	assorted	NC A&T		
TBCD workshops	assorted	NC A&T		Local campus

Products

All four of **SUCCEED**'s focus areas have taken steps to make permanent tangible contributions to their fields of expertise. The Faculty Development team has taken measures to train faculty development experts on each **SUCCEED** campus in how to deliver workshops on effective teaching. Instructor's materials were developed, including workshop planning templates and video tapes. The Outcomes Assessment team has developed a Best Practices in Outcomes Assessment manual and is refining the Curriculum Innovation and Renewal manual. Both of these have been widely distributed among department chairs and those responsible for ABET accreditation. The Student Transitions team produced workbooks containing resources in multidisciplinary design in preparation for the workshop on that topic. The team plans to expand the workbook to include the outcomes of the workshop, making it an excellent best practices document. The Technology-Based Curriculum Delivery team has developed a prototype of a web page generator using database input. Such a feature would allow the rapid creation of web pages for use as a class resource. A CD-ROM featuring some of **SUCCEED**'s best efforts is due to be released shortly.

Assessment and Evaluation

Since assessment and evaluation has been a concern in previous reviews, it is appropriate to identify here substantial accomplishments in assessment of the Coalition's programs.

A centralized database of engineering faculty at all of the **SUCCEED** campuses was established. This database will be used to track participation in faculty development and technology use as well as other **SUCCEED** activities. An email survey was administered to all **SUCCEED** engineering faculty on use of innovative teaching practices and campus

level of support for teaching—results are still being analyzed. Baseline information on existing faculty development programs was collected, and participant evaluations were collected at each workshop and with results summarized in workshop reports.

A questionnaire to establish baseline assessment of transitions courses will be completed by 8/98, and a faculty Instructional Technology Needs survey has been distributed and returned. Data for the latter are being entered into the database and are expected to be analyzed by June 15, 1998.

A study of degrees awarded by institution and engineering discipline for all **SUCCEED** participants has been completed using the Coalition's longitudinal database. The study reports percentage of entering students graduating in discipline first designated, percentage graduating in another engineering discipline, percentage graduating from another program at institution and percentage not earning a degree.

Three Diffusion of Innovation pilot studies are now complete. Reports discuss dissemination success factors for materials produced in three **SUCCEED** projects: "ViMS" (Visualizations in Material Science), "QIP" (Quality Improvement Partnerships), and "Mars Mission Navigator" (interactive multimedia tool for use in high school science courses). A fourth case study is now under way investigating the dissemination of the "Integrated Life Sciences and Engineering" Project.

NCSU Focus groups were held to gather input from the sophomore women students to better assess climate and retention issues. Results of this study are being analyzed, and will supplement the latest results of **SUCCEED**'s gender climate study, which will be released shortly.

Selected Course Modifications

At Clemson, four departments in the College of Engineering and Science are now actively using asynchronous learning networks in courses, and a fully asynchronous course will be offered in summer 1998. Multi-campus/multidisciplinary team projects were supported involving over 60 students.

In addition to the First-Year Engineering course mentioned earlier, FAMU-FSU will introduce a global awareness component in its new BS curricula.

NC State records a large number of course changes attributed to **SUCCEED** in addition to the scale-up of Introduction to Engineering mentioned earlier. An interdisciplinary pilot project was initiated with students from Chemical Engineering, Electrical Engineering, and Computer Science during Spring 1998. Web-based versions of seven engineering courses were offered on-campus during Fall 1997 and Spring 1998.

Along with the airing of ENGR 1201 on cable television mentioned earlier, UNC Charlotte reports that ENGR 1201 was modified to increase technical writing content, in

association with the University Writing Program and the English Department. Two new multidisciplinary projects and three other projects were added to the class.

In addition to the Camera Dissection laboratory mentioned earlier, Virginia Tech taught 6 pilot courses based on the **SUCCEED** curriculum model in year 6 and another is planned for year 7. The first freshman engineering course was transformed into a problem solving course with hands-on laboratory experiences and connections to engineering practice. Hands-on engineering experiences will be integrated in some sections of the Emerging Scholars Program in Engineering Calculus. Two divisions of the Virtual Corporation (VC) known as Distributed Information Systems Corporation (DISC) and Personal Electric Rapid Transit Systems (PERTS) were realized as courses with students from across the university. A pilot version of the Hands-on-Statics course (spring 98) was taught to sophomores from Building Construction and Engineering; the Hands-on-Statics lab will be integrated in two engineering statics courses (100 students) in Year 7. A vertically-integrated course in building design, Civil Engineering / Architecture was piloted, involving four projects in Spring 1998. A multidisciplinary, vertically integrated pilot course in Infrastructure Design was taught; the course will be integrated in the Civil Engineering curriculum in year 7. The Multimedia Statics Program was implemented in two sections of a Statics-Engineering Mechanics course. Many engineering students are now involved in multidisciplinary capstone design projects, including 70% of all students in Mechanical Engineering.

The University of Florida, in addition to its optimization of the IPPD program, has completely institutionalized the Freshman Introduction to Engineering Laboratory. A computer communications course using ALN in conjunction with a new textbook developed with **SUCCEED** support has been offered. The Emulated Flexible Manufacturing Laboratory is being integrated into UF courses, and a course on Computer Networks has been successfully taught via the WWW.

Special Programs for Student Success

Clemson introduced a mentoring pilot for 1998-99. The pilot was developed to handle a sample of 80 students.

At NC State, sixty under-represented minority students participated in the Summer Transition Program (STP) during July and August 1997. Sixty under-represented minority students participated in the START peer mentoring program during the 1997-98 academic year. A new women's peer mentoring program was developed in conjunction with SWE. Seventy junior and senior students have volunteered to mentor new freshmen in Fall 1998. College of Engineering Tutorial Services and Writing Assistance Programs were provided to students in the College of Engineering throughout 1997-98 to enhance retention. Success Revisited Workshops were initiated by the College during Spring 1998 to enhance the success of new students who were in academic difficulty during the fall semester.

UNC-Charlotte hosted 4300 High School students at "Explore UNC-Charlotte." The Intersociety Organization (ISO) was created as a joint venture of the various professional student societies, in order to benefit student transitions, such as mentoring programs. The College Alumni Group was chartered; it held two functions and created a web site including a searchable database of alumni. Engineering students may contact all alumni entered into the site for mentoring or professional development. Twelve students visited Aachen, German, with expenses paid by the College, to participate in the International Option program.

The University of Florida offered the STEPUP minority transition program with **SUCCEED** and UF funds in year 6 and obtained external funding to help support the program in future years. The Community College Transfer program was refined to be more cost effective and should be ready for full institutional adoption at the end of year 7. A professional communication (writing and speaking) component was piloted in the Civil Engineering Department.

At Virginia Tech, the ASPIRE '97 summer bridge program for Black engineering pre-freshman was held during July 1998 with 30 students participating. Of these, 22 students achieved grades B or higher in each of the academic subjects presented, thereby earning a book scholarship for fall 1998 semester. Fall Semester academic performance of the program participants was substantially better than the academic performance of non-participants. A "College Success Strategies" course was taught to approximately 30 students during Fall semester. Approximately 30% of these students earned a QCA of above 3.0, and 100% of the students earned a QCA above 2.0.

Web Pages

A variety of distributed development of WWW resources has occurred in the past year. Some of the more significant contributions already available and soon to be available are included in the table below.

Content featured	Web site address
NC A&T ABET EC 2000 planning	http://www.eng.ncat.edu/~sarin/abet_2000.htm
Multimedia Statics software site	ftp://www.ce.vt.edu/pub/statics/statics-zip/mle.exe
Georgia Tech **SUCCEED** activities	http://www.coe.gatech.edu/~succeed/
The Innovator newsletter	http://www.succeed.ufl.edu/pubs/innovator/
Outcomes Assessment Best Practices	http://www.succeed.vt.edu/products/outcomes/
Curriculum Innovation and Renewal	online by August 1, 1998
Videoconferencing web site	http://www.visc.vt.edu/succeed/conferencing/
New **SUCCEED** online directory	http://www.succeed.vt.edu/directory/
Jack Lohmann's EC 2000 presentation	http://www.multimedia.vt.edu/lohmann/
Virginia Tech Virtual Corporations	http://www.ee.vt.edu/virtcorp/
SUCCEED projects database	A prototype is under test.
Instructional site for developing WWW sites for hands-on projects and labs	http://nsf.me.vt.edu/nsf/

Educational and Assessment Infrastructure

A large number of accomplishments fall into this category, making it worthy of special mention. These examples of development of educational and assessment infrastructure provide compelling evidence that the facilities will be in place to institutionalize **SUCCEED** efforts.

At a presentation to a UF Department Chairmen's meeting on **SUCCEED** initiatives, each department agreed to appoint representatives to interact with the **SUCCEED CIT** in each of the four focus areas. UF has instituted a computer requirement, and Clemson is considering one—96 participants have been selected for Clemson's student laptop computing pilot. Clemson now reports that an ALN users group is now active, a student advising system will be available in August 1998, and a videoconference system has been installed to support an off-campus site. Twenty faculty have used the Educational Technology Lab to develop course materials, and

The NCSU College of Engineering will provide approximately $50,000 to renovate space and purchase furniture for the new Introduction to Engineering course, to be completed by September 1, 1998. The NCSU Center for Learning and Teaching was established and a director hired. At UNC-Charlotte, a distance learning training program was designed and implemented utilizing the "best practice" methodology from the **SUCCEED** Coalition. NC State collaborated with UNC Charlotte, NC A&T, and UNC Asheville to establish common web-based video teleconferencing system (MBONE) to enhance communication/collaboration on-campus and for distance-based course offerings. Shared web-based MBONE video conferencing technology with UNC Wilmington and Lenoir Community College. Participated in "video over IP" initiate with Southern Universities Research Association (SURA). Participated in the Southern Crossroads Initiative (Internet II) to develop videoconferencing and video-on-demand for remote collaboration. NC State established The Learning Technologies Service (LTS), in partnership with the Faculty Center for Teaching and Learning to serves as a campus focal point for educational technology activities. The LTS offers assistance in exploring, evaluating, and applying innovative multimedia applications and information resources to enhance student learning.

With the support of **SUCCEED** and the impetus of ABET's new Engineering Criteria, an infrastructure supporting assessment is being developed. ABET Program Coordinators have been appointed for each of 8 undergraduate programs at Clemson. A full-time database assistant was recruited and hired to develop and operate the UNC-Charlotte College of Engineering database. The "Best Practices in Outcomes Assessment" manual was distributed to all the engineering programs at each of the **SUCCEED** institutions. Georgia Tech has distributed a grading assistant program to better communicate with students their grades from assignments and exams in courses. This software is an Excel-based spreadsheet that connects to Tech's central student registration system whereby students enrolled in a class are automatically entered into a faculty member's spreadsheet along with their email addresses. The faculty member can then send email to each

student with their respective grade for an assignment with a button click and a histogram of all student scores is plotted on a course web page. This process greatly streamlines grading time for faculty and greatly improves communication with students concerning their classroom performance. The **SUCCEED** team was also instrumental in encouraging Georgia Tech to hire a Director of Assessment. The Director will report to the Vice-Provost for Undergraduate Affairs, but will oversee assessment at all levels of the Institute. This is a new position for Georgia Tech, so **SUCCEED** has taken the opportunity to both shape and support whomever will be hired.

D. Future Plans

SUCCEED's future plans are best described by our strategic plan, included in the appendix. Highlights of the plans are detailed here.

Faculty Development

Data from the faculty baseline survey of teaching practices and campus climate for teaching are currently being analyzed. They will be reported at the November Frontiers in Education Conference. The teaching leaders listserver will be used to provide continuing assistance to faculty development program planning efforts on all SUCCEED campuses. A coalition teaching effectiveness workshop will be presented at FAMU/FSU in October, and a topical workshop on technology-assisted instruction will also be presented during the year (with possibly a second topical workshop on a topic still to be determined). The Faculty Development CFT leaders have agreed to coordinate the next SUCCEED annual conference and the multi-coalition conference in April 1999. The latter will have faculty development as its focus theme.

Outcomes Assessment

Based on tested instruments and measures at **SUCCEED** institutions, best practices will be disseminated to the engineering education community through conferences, workshops, and publications. Faculty, especially those who will implement outcomes assessment processes and curriculum improvement in the degree programs, will be trained through a workshop held independently and as part of assessment conferences.

Student Transitions

The team will disseminate through conferences, workshops, and publications the best practices in multidisciplinary design identified in the workshop of the past year. The team will also benchmark existing student transitions efforts with a Coalition-wide survey. Best practices will be identified in bridge programs, peer mentoring programs, and in practice opportunities, such as internships, co-ops, and international experiences.

Technology-Based Curriculum Delivery

Recent recommendations by the External Advisory Board and the Deans Council indicate that the direction of this team be re-evaluated. This will be done by the team itself, in response to the Faculty Instructional Technology Needs survey, which will be analyzed this summer. Collaboration with the Faculty Development team has already begun that will demonstrate the appropriate use of instructional technology in ways that enhance learning.

E. Evaluation

SUCCEED's efforts in assessment and evaluation (A&E) are multifaceted, addressing the need for assessment at different levels and from different perspectives.

SUCCEED's A&E Effort

There are four levels of A&E need in **SUCCEED**: Coalition-wide, College-wide, degree programs, and individual projects. To coordinate A&E efforts across these four levels **SUCCEED** has established an Assessment and Evaluation Coalition Service Team (A&E **CST**). This team consists of A&E Specialists with knowledge and experience in both qualitative and quantitative A&E activity.

All **SUCCEED** teams and projects will develop and implement an A&E program as part of their Strategic Plan. Across the four levels of need (see Table 1) the A&E team's responsibility will be the following. At the Coalition-wide level the team is responsible for planning, conducting and reporting on the overall progress of the Coalition. It will also assist the Coalition Focus Teams (**CFTs**) to plan and conduct their own A&E. At the college level the A&E team will assist the Campus Implementation Teams (**CITs**) to plan and conduct their own A&E. This will be facilitated through an A&E Council on which each **CIT** and **CFT** has a representative. The degree program level A&E will be the responsibility of the Outcomes Assessment Focus Team. The A&E **CST** will assist the Outcome Assessment **CFT** with the **SUCCEED** longitudinal database as needed. At the individual PI project level the A&E **CST** will provide assistance to project PIs on an as-needed consultative basis to plan and implement effective project A&E activity.

Table 1: Levels of A&E Activity and Responsibility

Level	Activity	Responsible Team or Individual
Coalition	Campus Case Studies LDB update & reports CFT A&E Plans CFT A&E Effort	A&E CST A&E CST CFTs with A&E CST assistance CFTs
College	CIT A&E Plans CIT A&E Effort	CITs with A&E CST assistance CITs
Degree Program	OA Evaluation LDB use	OA CFT A&E CST
Projects	Project A&E Plans LDB use Project A&E Effort Innovation Diffusion Study	PIs with A&E CST assistance A&E CST PIs, CITs, DT CST A&E CST and DT CST

Qualitative A&E Campus Studies

Qualitative campus study visits will be conducted as part of the team's Coalition-wide A&E responsibility. These studies include interviews of participants, administrators, students and all **CIT** members on each campus to objectively assess and evaluate progress and achievements against the **CIT**'s plan for that institution and the deliverables for the Coalition. Four visits will be made each year so that all eight campuses will be visited twice in four years. Annual campus and Coalition reports will be prepared and submitted to the individual campuses and the Coalition Guidance Team.

Quantitative A&E Project Activity

Standard report needs relating to enrollment, retention, and graduation rates, as specific examples, will be identified and developed. **SUCCEED**'s longitudinal data base (LDB) of student demographics and performance will continue to be updated and refined annually. Four specific projects have been identified for study with the LDB to develop a process for general data access by others. The data gathered in a second version of the Student Climate Study initiated by the Women Engineer's Board will be analyzed and reported on as part of the Quantitative A&E Project.

Assist CITs, CFTs & PIs in A&E

Creating the A&E Council is the first task to be accomplished. It will consist of representatives from all **CIT**s and **CFT**s. The Council will be used to provide assistance to the **CIT**s & **CFT**s to develop and implement their own A&E plans. The A&E **CST** will over-view this development and its implementation process. It will further provide assistance on an as-requested consultative basis to meet individual project PI's specific assessment and evaluation needs.

Innovation Diffusion Study

One task under this objective will be to collect, create, distribute and maintain a catalog of **SUCCEED** products and curriculum components. A second effort to assist the dissemination function of **SUCCEED** will be conducting a study to determine what factors are important and how they affect the diffusion of educational innovations. This is being accomplished by conducting a series of pilot studies on how some of the more successful **SUCCEED** products have already diffused. The results will be used to create a process for determining the transportability of the remaining **SUCCEED** products developed in the first five years. These transportability results will be forwarded as recommendations for use to the Dissemination **CST**.

F. Dissemination

SUCCEED's dissemination philosophy is based on having Coalition directed, active dissemination and on focusing our efforts for maximum efficiency. We plan to actively disseminate our best products and interact with a partnership of schools to achieve and measure the impact of the Coalition's efforts. Traditional efforts, such as journal publications, conferences, newsletters, and the Internet will also be used to reach the larger engineering education community.

Council of Schools

The Council is a partnership with selected non-Coalition schools to disseminate **SUCCEED** products and to cooperate with their undergraduate reform efforts. The current membership was extended to eleven schools in 1998, with the addition of San Jose State University and Michigan Technological University. The other members of the Council are The University of Central Florida, The University of Louisville, Mississippi State University, The Polytechnic University of Puerto Rico, the University of Puerto Rico at Mayaguez, Southern Illinois University-Carbondale, The University of Tennessee at Knoxville, Tennessee State University, and Virginia Commonwealth University. The Guidance Team visited UTK in the fall of 1997 and has visits planned for two other members before the end of year six activities. Council members were also engaged at **SUCCEED**'s annual conference, and are in the process of creating profiles to aid interaction and these will be placed on the **SUCCEED** WWW home page.

Conferences

The Coalition had a display this past year at the annual ASEE Conference, the Frontiers In Education Conference, and at CNSF, the Coalition for the National Science Foundation. These opportunities to place **SUCCEED**'s efforts in the view of the broader engineering education community are important, but we plan a greater visibility at the ASEE conference in 1999. The hosting of the 1999 ASEE conference in Charlotte, one of **SUCCEED**'s institutions, holds promise for a strong **SUCCEED** presence. **SUCCEED**-developed workshops and a **SUCCEED** poster and demonstration session are expected to open up our best efforts to the broader community. The 5th annual **SUCCEED** Conference was held at Charlotte, NC, in March and approximately 120 attended. This conference continues to be an excellent forum for internal planning and dissemination, and this past year served as a point of interface for our Council of Schools members.

Dissemination Using a Variety of Media

SUCCEED utilizes the WWW for cost effective dissemination. This year the WWW home page has been renovated for easier access and speed. Outcomes Assessment information was added in January, 1998. A Java-based Participant Directory and pop-up mail forms were added in February. A listing of all **SUCCEED** products is in progress.

The Coalition products, such as technical papers and active software, are distributed in CD-ROM format at conferences. *The Innovator*, **SUCCEED**'s newsletter, continues to be published with a distribution of approximately 4000 per issue, including all U.S. engineering deans. The Spring issue, Number 9, came out in March 1998.

The Coalition will assist PIs in dissemination of their results. The initial effort is the production of a "**SUCCEED**'s Greatest Hits" CD-ROM for broad distribution. This is an overview of the ten of the best products from the last five years and has links to a summary by each developer and a final link to the full product or result.

Inter-Coalition Efforts

SUCCEED sponsored the formation of a Coalition Liaison Board from the various Coalitions. Director Tim Anderson chairs the Board in order to form linkages and cooperate in dissemination. The **SUCCEED** project information form was modified to create a standard form, and a database of all Coalition projects will be maintained at the NEEDS web site. The inter-Coalitions group agreed to hold topical workshops in common. The first of these, which focused on the freshman year, was held in February of 1998. The second, on outcomes assessment, will be hosted at the Rose-Hulman Institute of Technology in the fall. The third of these, on Faculty Development, will be hosted by **SUCCEED** in the spring of 1999.

G. Industrial Involvement

SUCCEED seeks industrial involvement in three capacities—a program (and Coalition) evaluation / advisory role, a financial support role, and a mentoring role. Mentoring is the most active of these, usually incorporating some element of the advisory / support roles.

Program evaluation / advising

As described in more detail in section I, Infrastructure, **SUCCEED**'s External Advisory Board serves in both a Coalition and a program advisory capacity. Employer input has been dominant in the assessment area—20 companies participated in evaluation of engineering program graduates at Clemson, and employer surveys were included in the Best Practices notebook produced by the Outcomes Assessment **CFT**. Assessment instruments have been collected from Boeing and other employers. Ed Lewis of Lockheed Martin and Barry Diamondstone of the National Quality Program at NIST, members of the **SUCCEED** External Advisory Board, have agreed to work with the team on developing an employer feedback project, and Ed Lewis spoke on a panel discussing employer feedback options at a **SUCCEED** best practices workshop.

Institutionalization / extension support

The most concise manner to convey this information is in the following table. This list is certainly not comprehensive.

Activity supported	Supported by	Support level if available
NC State Introduction to Engineering / Freshman Physics Student-Centered Learning	Equipment grant from Hewlett-Packard	$250,757
NC State Tutorial Services and Writing Assistance Programs	College of Engineering and General Motors	
NC State Interdisciplinary pilot	Wyeth-Lederle	
Virginia Tech ASPIRE '97	General Electric, Dow Chemical Company, and DuPont Committee for Student Success	 $39,000
Proposal: Virginia Tech ASPIRE 98	Corning Foundation	
Virginia Tech Virtual Corporations	Motorola Lockheed-Martin part of a grant of Westinghouse part of a grant of Center for Innovative Learning grant	$50,000 $70,000 $60,000
Virginia Tech Dissection Laboratory	Lockheed-Martin over three years Several companies (dissection items) Student Engineers Council	$80,000 $12,000 ea. $10,000
UF STEPUP program	Lockheed-Martin (endowment)	$400,000
Migration of **SUCCEED** innovations to Brazil / other parts of Central and South America	Lucent Technologies	$13,000
UF Online Degree program in EE	Sloan Foundation	$135,000

Mentoring / Consulting to Student Teams

This information is presented in the same manner as the previous section, but includes pertains to industrial involvement of a mentoring / consulting nature. While support level is included where the mentoring was accompanied by financial support, these figures do not include estimates of the value of the industry employee's time.

Activity supported	Supported by	Support level if available
Clemson Multi-Campus / Disciplinary Design	Westinghouse Savannah River	$70,000
Clemson Internationalization (EPIC)	BMW Manufacturing (2 internships) Fluor Daniel (2 internships) BASF Corporation (3 internships) Robert Bosch (1 internship) Square D Company (3 internships) Cryovac Corporation (1 internship) Dow Chemical (1 internship) Draexlmaier Automotive (1 internship)	$20,000 $20,000 $32,000 $8,000 $24,000 $12,000 $10,000 $6,000
FAMU-FSU Multidisciplinary Design Course	Cummins Engine Proposal for course w/ Proctor & Gamble	
NC State Women's Email Corporate Mentoring Program	5 pairs have been connected, effort will be expanded during 1998.	
NC State Multidisciplinary Teams	Glaxo Wellcome	
Va Tech Multidisciplinary Vertically Integrated Infrastructure Course	Class projects useful to Virginia DOT; Openaka Corporation VP and Executive Director of New River Resource Authority attended student presentations.	
Virginia Tech Employer Panel	3 engineering employers participated in a panel discussion focused on attributes and skills entry-level engineers are expected to have upon graduation. 150 freshman attended the event.	
UF Integrated Product and Process Design	In addition to mentoring student teams, each of 29 companies contributes $15,000 to offset program expenses. There is a long list of past and potential sponsors for future projects.	$435,000

H. Evidence of Culture Changes

Through our qualitative studies of **SUCCEED**'s third through sixth years we have found evidence of culture change that can be best described as "leveraged." That is, the areas in which **SUCCEED** has had the most success are areas which were independently deemed to be important by legitimate referents. For example, we have noticed some small but significant modifications in the faculty reward structure at member campuses. Many research institutions (and those that aspire to such status), such as the majority of **SUCCEED** institutions, tend to weight the faculty rewards, promotion and tenure decisions heavily toward scientific research and graduate education, often at the expense of undergraduate education. Since the inception of **SUCCEED**, coupled with state legislative initiatives to bolster undergraduate education, published research in engineering education journals has increased in value to promotion and tenure decisions to as much as 2/3 of the weight of published scientific research at some institutions, *provided* that the educational research is not perceived as frivolous. Even more positively, the provost at one member institution recently indicated that all legitimate scholarly contributions would be of the same value to him in the promotion and tenure process, whether in scientific research or in engineering education research.

The State of Florida has created and recently reauthorized a Teaching Incentive Program (TIP) for all State institutions whereby excellent teachers are rewarded with a $5000 increase in base salary. The FAMU-FSU College of Engineering has added to this incentive by providing a Teaching Incentive Award for excellent teachers within the college. The College of Engineering at Clemson has also funded a $6000 award to support and recognize teaching innovation, even without legislative initiative.

Another area where **SUCCEED** activities are leveraged with state legislative initiatives is in the creation of network based collaborative learning environments. The state of North Carolina has recently mandated that universities in the University of North Carolina (UNC) System provide educational opportunities to under-served areas of the state. The new president of the UNC system has also made distance education a top priority for her administration. This provides an excellent opportunity for **SUCCEED** funds to be leveraged with other state funds to provide distance education to the people of North Carolina. The colleges of engineering at NC State, NC A&T, and UNC-Charlotte are making this a priority. NC State, in partnership with NCA&T and UNC-Charlotte, is offering engineering courses to other UNC system schools using the MBONE (Internet Multicast Backbone) Virtual Classroom, which early **SUCCEED** funding helped make a reality. NCA&T and UNC-Charlotte also have plans to offer common courses jointly via distance education. The University of Florida has also leveraged its successes in Technology-Based Curriculum Delivery, and will develop a distance education degree program in Electrical Engineering. State of Florida support for this project will be $100K/year for five years.

In addition to leveraging state initiatives, **SUCCEED** also is becoming relevant to many who have not participated to date. In particular, the curriculum renewal and outcomes

assessment processes developed within **SUCCEED** fit well with the new Engineering Criteria 2000 of the Accreditation Board for Engineering Education (ABET). A recent **SUCCEED**-sponsored conference on outcomes assessment was attended by many department chairs and others, including a number of representatives from **SUCCEED**'s Council of Schools who had never before attended any **SUCCEED** activities. Georgia Tech's experience as a pilot school for the new criteria has been an important resource to the **SUCCEED** effort in this area.

In addition to outcomes assessment, the new ABET engineering criteria also require that students be able to design a system, component or process; function on multidisciplinary teams, solve engineering problems and use the techniques, skills and tools necessary for engineering practice that are also focus areas for **SUCCEED**. A number of projects that have already been tried and tested at member institutions are available for adoption. In this vein, Clemson has created implementation grants which are available to faculty members who wish to import proven **SUCCEED** projects from other member institutions. Virginia Tech allows sophomores to participate in senior design projects, in order to get hands on design and teamwork experience early in their careers.

Finally, **SUCCEED** has fostered a sense of community among those scholars who are dedicated to improving the undergraduate engineering experience. These professors, who may have felt alone in their departments, found like-minded peers in other departments at their home institution as well as at other institutions in **SUCCEED**. This community prevented many good ideas from withering on the vine due to lack of resources and support and helped the advocates of better undergraduate education reach the critical mass necessary to gain a voice among the faculty at the various colleges.

I. Infrastructure

The matrix team approach that couples Coalition Focus Teams to Campus Implementation Teams was expected to realize great management benefit. This benefit has been realized to an extent. A communication benefit has definitely been observed—in the planning and implementation of efforts specific to a single campus, the **CIT** members bring knowledge of approaches being used at other institutions, which they have learned through their **CFT** interaction. We have discovered, however, that some funding issues become more complicated using this structure. While our general approach has been to fund activities of Coalition-wide benefit through the **CFT**s and to fund activities that are campus-specific through the **CIT**s, we have found that black-and-white picture to have gray areas. As we become more successful at sharing campus-specific activities, the more they tend to be of Coalition-wide benefit. There is the additional complication that this structure causes the allocation to a single individual to come from multiple sources, generating additional paperwork. It is hoped that an accelerated schedule for allocating funds will alleviate the difficulties that this caused in the first year of this award.

A few changes in the structure and composition of **SUCCEED**'s leadership team bear mentioning. Since the original proposal for this award, there is new leadership in the Student Transitions area, namely Howard Phillips of UNC Charlotte and Dave Ollis of NC State. This change was the result of Sarah Rajala's request to step down to focus on leadership of the NC State **CIT** and of Jack Hebrank's return to his work in industry. More significantly, the TQM Coalition Service Team was merged with other Coalition efforts. In the Coalition's continuing effort to become a quality organization, we have discovered that the role originally defined for the Total Quality Management **CST** can be accomplished most effectively by distributing its responsibilities, thus permitting its dissolution. The development of metrics to assess the health of the Coalition, originally assigned to the TQM **CST**, is more appropriately carried out by the Assessment and Evaluation **CST**. More importantly, the most critical function of the TQM **CST**, that of driving the Coalition's development as a quality organization, can only be successful when integrated with the management of the Coalition itself. Thus, the remaining efforts of the TQM **CST** will be carried out in the Coalition administration.

The use of videoconferencing equipment has reduced travel cost and improved communication within **SUCCEED**'s Guidance Team and its other teams. As a result, the Guidance Team has been able to have more frequent, shorter meetings, while the Coalition Focus Teams, **CIT** leaders, and other groups, which previously could only meet face-to-face at the **SUCCEED** annual conference due to cost constraints, have benefited significantly from this new capability.

In restructuring its External Advisory Board, **SUCCEED** sought a strengthened relationship with industry to achieve the intellectual leveraging required to institutionalize of **SUCCEED**'s innovations. Our strategy has been to align our industrial partnerships with **SUCCEED**'s focus areas. This strategy has not only brought an industry perspective to program evaluation, but has also provided industry expertise to our teams.

J. Value Added by the Coalition

SUCCEED's role in the establishment of a community of engineering education researchers is clear. **SUCCEED**'s activities and its influence are seen in most issues of the Journal of Engineering Education (13 articles since 1993 feature **SUCCEED** activities). **SUCCEED**'s influence can also be seen regularly in ASEE's Prism magazine. More critical is **SUCCEED** more active role in fostering systemic reform—at the same time as **SUCCEED**'s focused dissemination to our Council of Schools promises to extend the reach of **SUCCEED**'s innovations, **SUCCEED**-founded inter-Coalition activity holds promise to extend the reach of the entire Coalitions program.

SUCCEED is also contributing to systemic reform through its strong presence at conferences, and expects an increased presence at the 1999 ASEE conference, since it is being hosted at a **SUCCEED** institution. This is discussed in greater detail in section F, Dissemination.

The work of our Outcomes Assessment team toward identifying best practices in that area is in great demand by the engineering education community, and information regarding Georgia Tech's experience from the ABET EC 2000 pilot is in great demand. The flagship Effective Teaching workshop in **SUCCEED**'s Faculty Development effort continues to be in great demand, and other workshops being patterned after its hands-on approach to teaching faculty new techniques hold promise for having a similar national impact. The Student Transitions team's recent workshop to define best practices in multidisciplinary design is expected to lead to a national workshop in this area, and we have similar expectations in other areas of the Student Transitions program. Recent strategies for collaboration between the Faculty Development and Technology-Based Curriculum Delivery teams are expected to yield clear demonstrations of the effective use of educational technology toward improved teaching and learning.

In all areas, **SUCCEED** is pushing the limits of engineering education in the United States. Our comprehensive and aggressive approach, coupled with our dissemination efforts, is expected to have a significant impact on the nation's engineering education system.

K. Budget Information

This section includes a detailed description of allocations for the period September 1, 1997 through August 31, 1998, referred to as "Year 6" or "Y6." Also included in this section is an itemized budget request for the period September 1, 1998 through August 31, 1999 ("Year 7") and forecasts of budget allocations by functional area for the remainder of the contract.

Funding was provided to the participating institutions by subcontracts for the annual period September 1, 1997 through August 31, 1998 of the cooperative agreement between the National Science Foundation and **SUCCEED**. The work to be performed under these subcontracts is a series of specific tasks. Each task is identified by a specific work statement under management by a designated principal investigator (PI). Each budget is required to specify a matching amount of cost sharing approved by the responsible institutional fiscal officer. Detailed budget allocations and matching funds for Year 6 follow.

Subcontracts were established December 1997 through February 1998, which slowed invoicing for Year 6. Therefore, invoicing information is not included in this report.

BUDGET TABLE OF ACRONYMS

CIT	CAMPUS IMPLEMENTATION TEAM
FD	FACULTY DEVELOPMENT
OA	OUTCOMES ASSESSMENT
ST	STUDENT TRANSITION
TBCD	TECHNOLOGY-BASED CURRICULUM DELIVERY
DT	DISSEMINATION TEAM
WEB	WOMENS ENGINEERING BOARD
A&E	ASSESSMENT & EVALUATION
TQM	TOTAL QUALITY MANAGEMENT

SUCCEED YEAR 6 (Period Sept. 15, 1997 through August 31, 1998)

BUDGET BY MAJOR AREAS

School	Total	CIT	FD	OA	ST	TBCD	WEB	A&E	TQM	DT
CLEMSON	$ 230,682	$ 139,325	$ 12,824	$ 31,317	$ 19,193	$ 23,023	$ 5,000	$ -	$ -	$ -
FAMU	$ 84,354	$ 66,700	$ -	$ -	$ 13,154	$ -	$ 4,500	$ -	$ -	$ -
FSU	$ 113,447	$ 66,700	$ 16,002	$ 10,153	-	$ 20,592	-	$ -	$ -	$ -
GEORGIA TECH	$ 269,390	$ 196,500	$ 18,183	$ 10,639	$ 16,116	$ 23,452	$ 4,500	$ -	$ -	$ -
NC A&T	$ 221,013	$ 126,500	$ 14,079	$ 11,083	$ 12,124	$ 12,727	$ 6,500	$ -	$ 35,000	$ 3,000
NC STATE	$ 639,766	$ 189,001	$ 144,862	$ 21,093	$ 44,820	$ 27,027	$ 5,000	$ 199,227	$ -	$ 8,736
UNCC	$ 295,763	$ 126,000	$ 20,633	$ 21,450	$ 71,007	$ 15,873	$ 4,500	$ -	$ -	$ 36,300
VIRGINIA TECH	$ 431,561	$ 189,500	$ 16,762	$ 44,152	$ 18,554	$ 100,815	$ 5,000	$ 15,000	$ -	$ 41,778
UF	$ 305,711	$ 189,499	$ 15,141	$ 20,736	$ 15,031	$ 25,597	$ 5,000	$ -	$ -	$ 34,707
UF Administrative	$ 280,673									
SUCCEED BUDGET	**$ 2,872,360**	**$ 1,289,725**	**$ 258,486**	**$ 170,623**	**$ 209,999**	**$ 249,106**	**$ 40,000**	**$ 214,227**	**$ 35,000**	**$ 124,521**
NSF TOT BUDGET	$ 2,900,000									
RESERVE BUDGET	$ (27,640)									

SUCCEED YEAR 6 - BUDGET ALLOCATION STATUS AS OF 5/30/98

SCHOOL	Task	PI	Approved NSF Funds	Match
Clemson	CIT Coord	Melsheimer	$12,925	$13,866
	CIT Team	Melsheimer	$126,400	$263,011
	FD	Hirt	$12,824	$12,825
	OA	Leonard	$31,317	$40,896
	ST	Sill	$19,193	$20,329
	TBCD	Page	$23,023	$23,146
	WEB	Lee	$5,000	$7,111
		CLEMSON S/T	$230,682	$381,184
FAMU	CIT Team	Awoniyi	$66,700	$66,700
	ST	Nnaji	$13,154	$13,154
	WEB	Nnaji	$5,000	$5,000
		FAMU S/T	$84,854	$84,854
FSU	CIT Team	Awoniyi	$66,700	$66,700
	FD	Buzyna	$16,002	$16,002
	OA	Braswell	$10,153	$10,153
	TBCD	Kuncicki	$20,592	$20,592
		FSU S/T	$113,447	$113,447
Ga Tech	CIT Team	Lohmann	$196,500	$284,395
	FD	Baker	$18,183	$18,183
	OA	Marr	$10,639	$10,639
	ST	Samms	$16,116	$16,116
	TBCD	McClellan	$23,452	$23,452
		GA TECH S/T	$264,890	$352,785
NC A&T	CIT Team	Murray	$126,500	$147,710
	FD	Nwankwo	$14,079	$14,947
	OA	Sarin	$11,083	$11,667
	ST	Murray	$12,124	$12,501
	TBCD	Ellis	$12,727	$16,951
	DT	Schimmel	$3,000	$5,565
	TQM	Harrigan	$35,000	$35,000
	WEB	Grace	$8,500	$10,638
		NC A & T S/T	$221,013	$254,979
NC State	CIT Team	Rajala	$189,000	$270,096
	FD	Brent/Felder	$144,862	$54,175
	OA	O'Neal	$21,093	$8,113
	ST	Hebrank	$3,688	$3,688
	ST	Ollis	$16,800	$16,800
	ST	Ollis	$20,644	$20,644
	ST	Rajala	$3,688	$3,688
	DT	Russ	$3,000	$3,000
	DT	Riddle	$2,738	$5,860
	DT	Miller	$3,000	$3,093
	TBCD	Miller/Brawner	$27,026	$27,065
	A&E	Zorowski	$199,227	$36,138
	WEB	Rajala	$5,000	$5,000
		NCSU S/T	$639,766	7,360

SCHOOL	Task	PI	Approved NSF Funds	Match
UNCC	CIT Team	Coleman	$126,000	$152,112
	FD	Phillips	$20,633	$20,633
	OA	Shelnutt	$21,450	$10,380
	ST	Phillips	$60,769	$60,769
	ST	Tolley	$10,238	$10,238
	TBCD	Quinn	$15,873	$15,873
	DT	Coleman	$33,300	$18,898
	DT	Shelnutt	$3,000	$3,000
	WEB	Tolley	4,500	$4,500
		UNCC S/T	$295,763	$296,403
Va Tech	CIT Team	Holzer	$189,500	$625,626
	FD	Holzer	$16,762	$16,762
	OA	Kurstedt	$32,998	$45,540
	OA	Muffo	$11,154	$11,700
	ST	Watford	$18,554	$18,554
	TBCD	Tront/Lockhart	$64,815	$80,178
	TBCD	Devenport/Kapania	$16,000	$15,747
	TBCD	Midkiff	$20,000	$16,365
	DT	Tront	$41,778	$41,906
	A&E	Marsh	$15,000	$12,332
	WEB	Watford	$5,000	$5,000
		VT S/T	$431,561	$889,710
UF	Admin	Anderson	$280,673	$198,192
	CIT Team	Latchman	$189,499	$771,596
	FD	Glagola	$15,141	$15,141
	OA	Elzinga	$10,368	$10,368
	OA	Legg	$10,368	$0
	ST	Jones	$15,031	$15,031
	TBCD	Latchman	$25,597	$25,597
	DT	Hoit	$28,707	$22,707
	DT	Kirmse	$3,000	$3,000
	DT	Tufekci	$3,000	$3,000
	WEB	Schaub	$5,000	$5,000
		UF S/T	$586,384	$1,069,632

		Percent Allocated	Total Matching Accounted For
TOTAL ALLOCATED	$2,868,360	99%	$3,900,354
RESERVE	27,140		
UNOBLIGATED	$4,500		Percent Matching
TOTAL NSF BUDGET	$2,900,000		134%

SUCCEED YEAR 6 (PERIOD Sept. 15, 1997 through August 31, 1998)

MATCHING FUNDS

SCHOOL	TOTAL FUNDS ALLOCATED	MATCHING FUNDS
CLEMSON	$ 230,682	$ 381,184
FAMU	$ 84,854	$ 84,854
FSU	$ 113,447	$ 113,447
GEORGIA TECH	$ 264,890	$ 352,785
NC A & T	$ 221,013	$ 254,979
NC STATE	$ 639,766	$ 457,360
UNIV FLORIDA	$ 586,384	$ 1,069,632
UNCC	$ 295,763	$ 296,403
VIRGINIA TECH	$ 431,561	$ 889,710
TOTAL	$ 2,868,360	$ 3,900,354

SUCCEED YEAR 6 (Period Sept. 15, 1997 through August 31, 1998)

FUNDS OBLIGATED / UNOBLIGATED

OBLIGATED		
SUBCONTRACTS	$	2,281,976
UNIVERSITY OF FLORIDA TEAMS	$	305,711
UNIVERSITY OF FLORIDA ADMIN	$	280,673
	$	2,868,360
UNOBLIGATED	$	31,640
TOTAL NSF FUNDS AWARDED YEAR 6	$	2,900,000

SUCCEED YEAR 7 - PERIOD:. SEPT. 1, 1998 THROUGH AUGUST 31, 1999

PROPOSED BUDGET BY MAJOR AREAS

CAMPUS IMPLEMENTATION TEAMS	$ 1,300,000
FACULTY DEVELOPMENT	$ 225,000
OUTCOMES ASSESSMENT	$ 225,000
STUDENT TRANSITION	$ 245,000
TECHNOLOGY BASED CURRICULUM DELIVERY	$ 225,000
DISSEMINATION TEAMS	$ 160,000
ASSESSMENT & EVALUATION	$ 210,000
ADMINISTRATION	$ 280,000
RESERVE	$ 30,000
PROPOSED NSF TOTAL BUDGET	$ 2,900,000

YEAR 2

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY

ORGANIZATION	PROPOSAL NO.	DURATION (MONTHS) Proposed	Granted
UNIVERSITY OF FLORIDA			
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR	AWARD NO.		
DR. TIMOTHY J. ANDERSON			

A. SENIOR PERSONNEL: PI/PD. Co-PIs, Faculty & Other Senior Associates (List each seperately with title; A.6. show number in brackets)	SUCCEED Funded Person-mos. CAL	ACAD	SUMR	SUCCEED Funds Requested By Proposer	Funds Granted By NSF (IF DIFFERENT
1. T. J. ANDERSON - DIRECTOR	3	0	0	31,483	$ 0
2. M. I. HOIT - ASSOCIATE DIRECTOR	0	2	0	14,955	0
3. H. LATCHMAN - INVESTIGATOR	0	0.24	0	1,800	0
4.	0	0	0	0	0
5.	0	0	0	0	0
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)	0	0	0	0	0
7. ( ) TOTAL SENIOR PERSONNEL (1-5)	3	2.24	0	48238	0
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST-DOCTORAL ASSOCIATES	12	0	0	39,456	0
2. ( ) OTHER PROFESSIONALS	0	0	0	0	0
3. ( ) GRADUATE STUDENTS				73,377	0
4. ( ) UNDERGRADUATE STUDENTS				0	0
5. ( ) SECRETARIAL-CLERICAL	12			20,800	0
6. ( ) OTHER (Res. Coord.) + Mentors/Tutors	12			53,656	0
TOTAL SALARIES AND WAGES(A+B)				235,527	0
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)25% of A.7,B.2,B.5 +res. Coord /$363/mm health				53,656	0
TOTAL SALARIES, WAGES AND FRINGE BENEFITS				289,183	0
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000:)					
TOTAL PERMANENT EQUIPMENT Funds Requested from NSF				5,000	0
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				42,000	0
2. FOREIGN (ICEE)				8,500	0
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
(0) TOTAL PARTICIPANT COSTS				0	0
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				13,657	0
2. PUBLICATION COSTS / Documentation / Dissemination / Final reporting costs				10,156	0
3. CONSULTANT SERVICES				0	0
4. COMPUTER (ADPE) SERVICES				0	0
5. SUBCONTRACTS				2,300,900	0
6. OTHER (INCL FOOD COSTS $2,000)				43,876	0
TOTAL OTHER DIRECT COSTS				2,368,589	0
H. TOTAL DIRECT COSTS (A THROUGH G)				2,713,272	0
I. INDIRECT COSTS (SPECIFY RATE AND BASE) 46% MTDC					
TOTAL INDIRECT COSTS				186,728	0
J. TOTAL DIRECT AND INDIRECT COSTS (H+I)				2,900,000	0
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPM 252 AND 253)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 2,900,000	$ 0

M. COST SHARING: PROPOSED LEVEL $2,900,000 AGREED LEVEL IF DIFFERENT $

PI/PD TYPED NAME & SIGNATURE	DATE	FOR NSF USE ONLY
Dr. Timothy J. Anderson Timothy J. Anderson		INDIRECT COST RATE VERIFICATION
INST. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date of Rate Sheet / Initials-DGC

BUDGET JUSTIFICATION PAGE

E. TRAVEL

FOREIGN - Trip to ICEE (International Conference in Engineering Education) AUGUST 1999 - Czechoslovakia - 3 Principal Investigators from SUCCEED Coalition to learn from the international engineering education community.

G.6. OTHER

Includes $2,000 food costs to encourage undergraduate student participation
Planned - 10 meetings (50 students) $200 each.

SUCCEED YEARS 8 - 10 PROPOSED BUDGET BY MAJOR AREAS

	YEAR 8	YEAR 9	YEAR 10
CAMPUS IMPLEMENTATION TEAMS	$ 1,345,000	$ 1,420,000	$ 1,545,000
FACULTY DEVELOPMENT	$ 225,000	$ 225,000	$ 150,000
OUTCOMES ASSESSMENT	$ 225,000	$ 225,000	$ 175,000
STUDENT TRANSITION	$ 200,000	$ 200,000	$ 150,000
TECHNOLOGY BASED CURRICULUM DELIVERY	$ 225,000	$ 225,000	$ 200,000
DISSEMINATION TEAMS	$ 160,000	$ 160,000	$ 200,000
ASSESSMENT & EVALUATION	$ 210,000	$ 210,000	$ 200,000
ADMINISTRATION	$ 280,000	$ 280,000	$ 280,000
RESERVE	$ 30,000	$ 30,000	$ -
PROPOSED NSF TOTAL BUDGET	$ 2,900,000	$ 2,900,000	$ 2,900,000

Appendix I. Engineering Enrollment and BS Degree Statistics

Beginning in 1989, the year the first **SUCCEED** proposal was prepared and submitted to the National Science Foundation EEC Program, the Coalition has tracked enrollments and degrees awarded in its participant institutions. Enrollment data includes all students, African Americans, Hispanics, Native Americans and Women. Bachelor degrees awarded to these same groups have also been tracked. The statistics used here are obtained from the annual reports of the Engineering Manpower Commission of the American Association of Engineering Societies, Inc. The most recent results of this study in terms of percentage changes since 1989 for the Coalition are presented in the table. Also included are the percentage changes for all other engineering schools in the country. All calculated results have been corrected for changes in total enrollment using 1989 as the base year.

Engineering Enrollment and BS Degrees Statistics

Enrollment (1989-1996)

	% increase in SUCCEED	Percent of all SUCCEED	% Increase in Adjusted National	Percent of all Adjusted National
African American	44%	16%	13%	6%
Hispanic	63%	4%	36%	8%
Native American	81%	<1%	79%	1%
Women	16%	21%	13%	19%

BS Degrees (1990-1997)

	% increase in SUCCEED	Percent of all SUCCEED	% Increase in Adjusted National	Percent of all Adjusted National
All Students	25%	N/A	7%	N/A
All Minorities	96%	17%	83%	11%
Women	34%	20%	29%	19%

* - Adjusted National (all U.S. Colleges minus SUCCEED Schools)

In enrollment it is seen that the percentage increase for African American, Hispanic and Native American undergraduate students for **SUCCEED** continues to be greater than that for the remainder of the engineering schools in the country. In addition the percentage of African American students of all students in **SUCCEED** is more than two and a half times that percentage figure for all other engineering schools. However, the percentage of Hispanic and Native American students of all students in the Coalition is still less than for the remainder of the country. The percentage increase in women students in the Coalition is only slightly greater than that of the rest of the country. This is also true in the percentage of women of all students.

In degrees awarded the Coalition's performance is better than the remainder of the country in the three categories compared: all students, all minorities (African American, Hispanic and Native Americans) and women. The increase in the percentage of total degrees awarded is more than three times that of the remainder of the nation. Since this

result has been corrected for changes in annual total enrollment it is indicative of an improvement of retention across the board. The increase of the percentage of degrees awarded to all three-minority groups has occurred at a faster rate over the past four years than for the same groups nationally. This is not the case with degrees awarded to women. For the Coalition schools the rate of change over the past two years has been either the same or somewhat less than the rest of the country.

It is concluded that the early student transition efforts expended by **SUCCEED** in its first five year award and the increased attention that the Coalition Institutions have placed on improving the success rate of students, particularly in the minority groups, have had a positive impact on raising both graduation rates and enrollment.

Appendix II. Curriculum Profiles of SUCCEED's Member Schools

CLEMSON UNIVERSITY

Curriculum Prior to 1992

Seven departments in the College of Engineering offered baccalaureate degrees in eight professional disciplines (Agricultural, Ceramic, Chemical, Civil, Computer, Electrical, Industrial, and Mechanical Engineering), all of which were accredited by ABET. An additional non-traditional and intentionally non-accredited program was offered in Engineering Analysis. Graduate degrees at the masters and doctoral level were offered in all of these disciplines, as well as in Bioengineering, Engineering Mechanics, Environmental Systems Engineering, and Materials Science and Engineering. The engineering undergraduate enrollment was 3070 students, of which 18.4% were female and 11.9% were African-American. There were 162 full-time faculty.

All undergraduate curricula were strong and traditional with minimal subject integration, emphasis on teamwork limited primarily to capstone design courses and some labs, and an educational culture that could often be characterized as "survival of the fittest". Curricula ranged from 138 to 145 credit hours. All students entered a common freshman year curriculum which included virtually no engineering content. The principal freshman engineering course was devoted primarily to instruction in programming. Design was introduced gradually within each major course sequence, culminating in strong capstone design courses in most programs. With the exception of Mechanical Engineering, there was little emphasis on design prior to the junior year. Engineering practice was included in the programs of a large fraction of students via an optional co-operative education program. While Clemson engineering has traditionally valued quality undergraduate education, there was little overt attention to recognition of faculty for excellence in undergraduate teaching, nor any organized program to help faculty develop their teaching skills. Tenure/promotion (TPR) reviews tended to focus heavily on research and graduate education.

Current Curriculum

Engineering student enrollment is now 2837, with the percentage of women and African-Americans 20.8% and 11.2% respectively. The faculty has decreased slightly to 155, and degree offerings are unchanged. A "zero-based" revision of all engineering curricula, stimulated by our participation in **SUCCEED** and input from our Industrial Advisory Board, was conducted in 1994-95. The objective was to address the desired attributes of graduates as defined in **SUCCEED**'s curriculum model while striving for lean, focused curricula.. Two departments (IE, ME) used the **SUCCEED** Curriculum Renewal Process, and the others used many of the same principles in developing their new curricula. The resulting curricula range from 130 to 141 credits, an average reduction of 7 credits. All provide increased emphasis on design, teamwork, and communications. The new freshman curriculum includes a problem solving and design course (replacing computer programming), and a recommended elective in History, Technology, and Society. The freshman engineering class is taught by experienced,

tenured faculty rather than by graduate assistants and temporary faculty as was often the case in the earlier FORTRAN class.

Curriculum integration is addressed in different ways in the various programs. Chemical Engineering, for example, uses a process case study approach to provide a unifying thread through the curriculum. The student designs pumps for this process in the fluid mechanics course, designs reactors for the same process in the reaction kinetics course, etc. In the Civil Engineering curriculum a sophomore/senior design course exposes beginning students to design, and to the expertise which they will gain later in the curriculum as they work with seniors in design exercises. In Mechanical Engineering an integrated 4-semester lab sequence ties together courses taken during each semester rather than serving a particular course. The sophomore lab, for example, concentrates on "discovery" and "observation" of principles being studied in Statics, Dynamics, Mechanical Systems, and Energy Systems courses taken in the sophomore year.

Oral and written communications skills begin with a firm grounding in the freshman year, and are thoroughly integrated into the balance of the curricula. Instruction in written and oral communication is especially emphasized within the framework of the laboratory and design courses. Similarly, computer skills have been woven throughout the curricula. A focus on international experience for graduates responds to the globalization of industry and of engineering practice, and to the international character of industry in South Carolina. Multidisciplinary design programs are now available in several curricula.

An advising/mentoring program for women (WISE -Women in Science and Engineering) now parallels our successful program for minorities. WISE focuses on enhancing the retention rate for female students, and attracting women into science and engineering. Faculty development is insitutionalized within the College through an Effective Teaching and Learning series of seminars and workshops which draws on both in-house expertise and on outside speakers such as Dr. Richard Felder of NC State/**SUCCEED** and Dr. Louis Quinn of Drexel/Excel. Participation in this series is led by the active involvement of college administrators. Assessments of teaching effectiveness now play a major role in TPR reviews, and publications and grants in education are weighted equally with those in disciplinary research. New college-wide awards for outstanding teaching parallel long-standing awards for research, and a new Faculty Teaching Fellow program recognizes and rewards faculty teaching leaders who also serve as mentors for junior faculty.

In 1995 the University underwent a major reorganization which merged 15 engineering and science faculties into a single College of Engineering and Science. Formation of a cohesive college from this diverse group has created an environment that fosters innovations in education and research. Engineering and science faculty now sit on a common curriculum committee, promoting dialogue on courses, teaching, and curricula. The College has developed a strategic plan aimed at capitalizing on its new organization, a process in which the **SUCCEED** Campus Implementation Team provided leadership in the teaching area. Mission, Vision, and Guiding Principles statements affirm the importance of undergraduate education in our college, and our commitment to being

leaders in engineering and science education. This strategic plan offers an exciting path forward toward more complete realization of the goals of **SUCCEED**.

Envisioned Curriculum

All core elements of **SUCCEED**'s curriculum model will be institutionalized, including incorporation of appropriate elements into science curricula within our expanded college. Students will enter a college committed to providing them with the skills and support needed to ensure that they have the opportunity to succeed, and which offers an education which prepares them for careers reaching well into the 21st century. Graduates will be creative problem solvers, able to function well on multi-disciplinary teams, understand the value of diversity in such teams, possess strong communications skills, have the motivation and ability for life-long learning, and have the skills needed to function in a global engineering arena. At the same time, they will possess the high level of technical competency which must be the keystone of engineering and science education.

Drawing from established **SUCCEED** models, the college will provide support and mentoring programs for all of its students in order to maximize the opportunity for student success, with focused programs addressing the special needs of minorities and women. The freshman program will not only introduce the essential concepts of engineering problem solving and design, but will also begin to build the teamwork, communications, and independent learning skills which will be developed throughout the curriculum. Freshman courses in science, mathematics, and English will be closely linked to the content of the freshman engineering sequence, providing greater motivation to the students taking these foundation courses for the balance of the curriculum.

All curricula will include team-oriented, industrially-relevant capstone experiences, with the majority of students participating in multidisciplinary team projects that reflect the real-world of engineering practice. At least 80% of graduates will have engineering practice experience gained through opportunities ranging from co-op education to industry partnership programs drawing from **SUCCEED** models. Instruction and/or practice in communications skills will be incorporated in each semester of the curriculum. At least 10% of the graduates will participate in international experiences through internships or study abroad, and enrich the international awareness of their classmates by bringing their experience back to the classroom.

A strong, institutionalized Faculty Development program offered by the college will incorporate programs developed by **SUCCEED** to specifically address engineering education, as well as using other on-campus and off-campus resources. A strong emphasis will be placed on active/ collaborative learning and on understanding diverse learning styles. The college will support faculty in implementing educational and technological tools that make their teaching more effective and efficient. The teaching awards given by the college will be its most prestigious faculty awards, and effective teaching will be essential to success in TPR reviews.

The integration of educational technology into the engineering classroom will provide more effective, efficient and far-reaching education. With all classrooms

equipped with computer projection systems and network connections, faculty will commonly use the world wide web as an integral part of their classes, and multimedia visualizations will make abstract concepts concrete. Students will use group collaboration software to overcome time and space barriers to teamwork in problem solving and projects. Virtual reality will bring the real world to the campus, and network technology will extend a virtual campus into the real world. Advising and mentoring will be enhanced through the use of the world wide web, newsgroups, and other network tools.

A continuous improvement program, based on the **SUCCEED** curriculum renewal process and using outcomes assessment tools validated by the **SUCCEED** Outcomes Assessment team, will be fully institutionalized. The outcomes assessment tools will address not simply technical competence, but the full spectrum of attributes which **SUCCEED**'s curriculum model is designed to produce, and which are also embodied in the new ABET Criteria 2000. This continuous improvement process will not only provide continuous improvement in terms of meeting **SUCCEED**'s objectives, but continuous adaptation of the curriculum model itself to meet the changing needs of the next century.

FLORIDA A&M UNIVERSITY-FLORIDA STATE UNIVERSITY

Curriculum Prior to 1992

The FAMU-FSU College of Engineering was established in 1982. The mission statement of the College states that "the primary goals are to educate engineers of excellence at both undergraduate and graduate levels, judged by the highest standards in the field and recognized by national peers; to attract and graduate a greater number of blacks, other minorities, and women into professional engineering, engineering teaching and research; and to attain national and international recognition of the College through the educational and the professional service of its faculty and students."

By 1992, the College had established BS degree programs in five areas of engineering (Civil, Chemical, Electrical, Industrial, and Mechanical), and all five BS degree programs had attained full-term ABET accreditation. Undergraduate enrollment was over 1750 students, and graduate enrollment in four areas of engineering was over 140.

In 1992, BS degree programs at the College required between 134 to 144 credit hours and an average full-time residence of five academic years. All students, then as now, must take usual courses in the basic sciences and mathematics, and a number of core courses (Mechanics, Graphics, Electrical Engineering, Engineering Economy, and Computer Programming) before proceeding to specialization courses. Life-long learning was enforced through a coverage of fundamentals in engineering sciences. From all indications (job offers, graduate school admissions, etc.), BS graduates from the College were highly regarded by industry and graduate schools.

The College had maintained a very successful minority recruitment program that started in 1986. The components of this included a pre-college summer subprogram called Minority Introduction to Engineering (MITE) and a freshman preparation subprogram called Engineering Concepts Institute (ECI).

Culturally, classes consisted of students who had come from widely varied backgrounds. Faculty too was of very diverse cultural background and professional experience. Student demographics showed 35% minorities and 25% women in 1992. By 1994, the College had graduated 1,254 students with BS, 197 MS, and 8 Ph.D. Of those alumni, African-Americans numbered 255 BS, 17 MS, and 1 Ph.D.; 245 were women. The College as a whole was, then as now, a truly multicultural environment.

Current Curriculum

The College mission statement remains the same as it was in 1982. But the curricula have undergone substantial improvement in all aspects. The student population of the College and affiliated engineering programs has grown to over 2000 today. The enrollment is about 50% minorities and 25% women. There are over 70 faculty and 50 support staff.

There are BS and MS programs in Chemical Engineering, Civil Engineering, Electrical Engineering, Industrial Engineering, and Mechanical Engineering. There are doctoral programs in Chemical Engineering, Electrical Engineering, and Mechanical Engineering. Doctoral programs in Industrial Engineering and Civil Engineering have been proposed.

BS degree curriculum credit hours now range between 128 and 134, reflecting a change of views at the political level (as indicated by recent Board of Regents requests) and also reflecting greater efficiency in instructional processes (resulting from suitable use of computer networking and related technologies).

Many courses in the curricula now feature team-based projects designed to facilitate student transition into industrial organizations. One BS curriculum and one MS curriculum have been selected for full participation in a major "distance learning" project at FSU. A regular series of college-organized workshops on the use of multimedia and the Internet in instructional processes has been initiated. The College is currently preparing for an ABET accreditation visit scheduled for Fall 1997.

When the opportunity came in 1992 for the FAMU-FSU College of Engineering to participate in **SUCCEED**, the College saw it as a major means of achieving a substantial part of its mission. The College promptly agreed to participate as a member institution. However, the nature of the College as the engineering college of two universities did affect its participation logistics adversely at the beginning of **SUCCEED**.

The initial imperfections in logistics were removed by 1993, and the College thereafter became as active in **SUCCEED** as the other member institutions.

The first five years of **SUCCEED** at FAMU-FSU College of Engineering have been beneficial for the curricula in several respects. First and foremost, **SUCCEED** activities have greatly enhanced the respectability of instructional experimentation among faculty. Faculty are beginning to cite instructional development activities as contributions of significance in their promotion applications. Indeed, faculty from all academic departments are now looking forward to participating in the much-anticipated **SUCCEED** implementation phase.

SUCCEED activities have also resulted in institutionalized TQM-based programs in one department. One such program is the Mastery Learning Program (MLP) in the Industrial Engineering Department. The MLP has proved to be effective for insulating student mastery of subject matter from certain background variations. A full description of MLP is to appear in the next issue of **SUCCEED** newsletter.

In 1995 and 1996, **SUCCEED** was also helpful in expanding the ECI program. The program is currently being restructured to utilize computer networking and related **SUCCEED** products in enhancing and monitoring freshman performance.

Following FAMU-FSU's ABET visit in fall 1997, the FAMU-FSU Executive Council (Dean, Associate Dean, all Department Chairs) asked the FAMU-FSU **CIT** to spearhead a BS curriculum renewal in each of the five departments in accordance with ABET Engineering Criteria 2000, **SUCCEED** Curriculum model, and the mission of FAMU-FSU. A joint meeting of the FAMU-FSU **CIT** and the College Curriculum Committee was held every week in spring 1998. The first curriculum renewal report to the Executive Council is due in June 1998. A new First Year Course is being introduced, and the first version of a computer-administered common exit exam in Calculus I will be available in August 1998. The Mechanical Engineering Department curriculum renewal is progressing as planned, and the industry-sponsored multidisciplinary design course with Cummins Engine continues; a proposal for a similar course with Proctor & Gamble is being reviewed by P&G.

Envisioned Curriculum

In accordance with its mission statement and sentiments recently expressed by its stakeholders, the FAMU-FSU College of Engineering is committed to attaining excellence in all dimensions of engineering education through a mindset of continuous innovation and improvement. This commitment to excellence is in agreement with **SUCCEED**'s curriculum model. In particular, the characteristics of graduates defined in this model are some of the characteristics that the College stakeholders want in its graduates. Accordingly, the College regards participation in **SUCCEED** implementation phase in the next five years as a very important undertaking.

This commitment of the College has been translated into specific objectives. In the next decade, in addition to usual objectives regarding curriculum contents and its integration, the FAMU-FSU College of Engineering shall continually address the following objectives:

(a) The College shall continually improve its effectiveness through innovative applications of computer networking and related technologies in instructional delivery and student learning. The main goal of that is to increase student graduation rate and graduate quality at the same time. One department is already investigating the use of "virtual reality" to accelerate student learning in manufacturing engineering.

(b) The College shall enhance student transition into industry through various innovative methods, utilizing results developed by **SUCCEED** and other NSF Coalitions. This shall involve regular opinion surveys to determine what is needed by industrial organizations. The College is already including team-work topics in some of the courses; it also requires every student to take the "Fundamentals of Engineering" examination before graduation.

(c) The College shall encourage faculty to experiment with and adopt instructional processes and systems developed by **SUCCEED**, the other NSF Coalitions, and similar organizations. To facilitate this, the College is already developing a WWW-based procedure for calling faculty attention to various types of instructional processes and systems, especially those developed by **SUCCEED** and other NSF Coalitions.

(d) The College shall develop a multi-dimensional (faculty) reward system that takes into account instructional improvement as an important contribution by individual faculty. The College regards this as a desirable cultural change.

(e) The College shall continually assess and enhance its alumni-related performance. Life-long learning shall be encouraged in all engineering science courses. Alumni performance assessment shall be done and utilized in the spirit of new ABET accreditation procedures and Criteria 2000.

(f) The College shall actively seek industrial partners in suitable aspects of its curriculum improvement. An annual "Industry Day" has already been established.

(g) The College shall develop innovative programs to enhance the success of engineering freshman since statistics have clearly indicated that good freshman performance is usually attended by good overall college performance. That statistical result is especially true for minorities and other disadvantaged groups. The College is currently expanding the ECI program into a comprehensive freshman program through which freshman advising, counseling and research subprograms shall be institutionalized. In the same vein, one department already offers an innovative first-year course entitled "Engineering Concepts".

(h) To measure its performance relative to objectives (a)-(g) above, the College shall utilize standard statistical methods and "Outcomes Assessment" tools developed by **SUCCEED**.

Achieving the objectives (a)-(h) above without an unnecessary increase in curriculum credit hours shall be regarded as a task that must be done. Since these objectives of the FAMU-FSU College of Engineering are directly serviced by the four "Focus Areas" being proposed for **SUCCEED** implementation in the next five years, the College shall naturally treat **SUCCEED** implementation plans with full commitment.

GEORGIA INSTITUTE OF TECHNOLOGY

Curriculum Prior to 1992

In 1991, the College of Engineering was comprised of eight schools: Aerospace Engineering, Chemical Engineering, Civil Engineering, Electrical Engineering, Industrial and Systems Engineering, Materials Science and Engineering, Mechanical Engineering, and Textile and Fiber Engineering. Two schools have since modified their names to reflect their increased academic strength in two areas. They are now known as Civil and Environmental Engineering and Electrical and Computer Engineering. Collectively, these eight schools offered 23 degree programs at the bachelor's, master's and/or doctoral levels. They included: aerospace engineering, bioengineering, ceramic engineering, chemical engineering, civil engineering, computer engineering, electrical engineering, electrical and computer engineering, engineering science and mechanics, environmental engineering, health physics, health systems, industrial engineering, materials engineering, mechanical engineering, metallurgy, nuclear engineering, operations research, polymers, statistics, textile chemistry, textile engineering, and textiles. The undergraduate enrollment in the Fall of 1991 was 6,271 students, of which 1,263 (20.1%) were women, 555 (8.9%) were minorities. Georgia Tech ranked 2nd among engineering schools nationally in terms of the total number of degrees awarded in AY 1991-92, awarding 1,838 B.S., M.S., and Ph.D. Degrees, following the University of Illinois with 1,844 degrees.

Georgia Tech is unique among many engineering schools, and certainly considering the size of the population of the State of Georgia, in that it is the only publicly funded engineering college in the state. Approximately 70% of Georgia Tech undergraduate students are residents of Georgia, the remainder are out-of-state students mostly from the southeast, midwest, and northeast. The College has a transfer program with eight Georgia universities, referred to as the Regents' Engineering Transfer Program, and a Dual Degree program with about twenty universities both within the state and nationally.

In the Fall of 1991, there were 254 engineering faculty, 14 were women, and 12 African-American and Hispanic faculty. The engineering faculty were engaged in both

undergraduate and graduate instruction and actively engaged in research. The reappointment, tenure, and promotion documentation and process was typical of a large, research-oriented university.

All of the undergraduate engineering programs were ABET accredited, having just completed an ABET review in 1990. Most programs were given a full six-year accreditation, although some were given a three accreditation with a subsequent visit (and all were accredited for another three years). The length of the curricula varied from 203 quarter hours for Electrical and Computer Engineering to 207 quarter hours for Textile and Fiber Engineering. All curricula included capstone design experiences, however, it should be noted that Georgia Tech has one of the nation's oldest and largest co-op programs. Approximately, 40% of Georgia Tech students participate in the program. Recruiters frequently cite the can do" attitude of Georgia Tech engineers as among the reasons they recruit at Georgia Tech. We attribute much of this to the co-op program. While the campus had (and continues to have) strong multi-disciplinary and inter-disciplinary research programs, inter-disciplinary instructional activity at the undergraduate level was much less so. Computational facilities were provided at the Institute and School level primarily through computer clusters. Instruction was provided mostly in the typical lecture, recitation, and laboratory mode.

Current Curriculum

The current degree programs remain the same except that the ceramic engineering program is being phased out and folded into the materials science and engineering degree program. The College of Engineering is now the nation's largest engineering program in terms of degrees awarded. In 1995-96 the College of Engineering awarded 1,413 bachelor's, 650 master's, and 171 doctoral degrees for a total of 2,234 degrees. Of the total, 21.1% were to women, and 12.2% were to minorities. The number of faculty has grown to 323, of which 20 are women and 23 are minorities. The next ABET visit will be in the Fall of 1997. Georgia Tech was granted a one-year extension by the EAC in its current accreditation period due to the disruptions that were caused from the summer into the fall as consequence of hosting the 1996 Olympic Village.

In 1994, the College reviewed and revamped its reappointment, tenure, and promotion (RPT) process. A primary result was to reduce the breadth and length of the RPT documentation and to enhance a focus on the review of the quality and impact of a candidate's achievements. Candidates now provide five intellectual products of their work which are reviewed by a committee qualified to assess the technical material. Products can include such items as papers, books, and CDs, and can cover any aspect of research or instructional innovation as desired by the candidate.

Since 1991, four decisions have had, and will continue to have, a significant effect on the undergraduate curriculum. In 1992, the Board of Regents mandated a phased-in program focusing on learning outcomes assessment for all undergraduate programs throughout the University System. Further, in 1995, the Board decided to

convert the University System from quarter based programs to semester based programs by the Fall of 1998 with a limitation of a maximum of 120 semester hours. Georgia Tech will seek an exemption for a maximum of 130 semester hours (and current indications are that it will be granted). Georgia Tech was granted one additional year to convert because of the disruption caused by the Olympic Games in the summer of 1996. Additionally, Georgia Tech decided in 1995 to require the purchase of a computer by all entering Freshman beginning in the Fall of 1997. Finally, Georgia Tech has been selected to be among four institutions to pilot the ABET Criteria 2000 in the Fall of 1997. The combination of these four events presents both a considerable challenge but also a special opportunity in which **SUCCEED** can play a role.

SUCCEED has been a positive influence in the undergraduate engineering programs at Georgia Tech, and at all levels. For example, through **SUCCEED** support our Office of Minority Educational Development (OMED) has continued to make progress in facilitating the transition of freshman minority students to Georgia Tech through its successful program Challenge. Challenge students now earn higher first quarter GPAs than non-Challenge minority and majority students. While Georgia Tech had already begun the Challenge program before **SUCCEED**, a major contribution of Georgia Tech through **SUCCEED** support was to facilitate the transfer of the program to other **SUCCEED** universities for implementation in their institutional settings.

In our basic physics course, electricity and magnetism, we have developed a psychometric procedure involving discriminant analysis to predict students at risk with greater than 70% accuracy. Once identified these students were then involved in a fluency-based program, called Precision Teaching, to better their skills to successful problem solving in the course. Because of the success of the program, it is presently being scaled up to be an integral part of the educational experience for the nearly 1,000 students that take the course each year. Further, the program has been tested at VPI, and both NC A&T and UNC-Charlotte are in the process of testing the program at their institution.

In another lower-level course, CS 1502 Introduction to Computer Programming, we have developed a theory of cognitive media types that allow multiple types of courseware to be organized and presented in a manner that is based on the informational and learning needs of the student. Cognitive media types characterize information in cognitive terms, for example, definitions, examples, problems, instead of physical terms such as text or video. Using this organization, students can choose to view, say, an example or a worked problem. Through the development of a multimedia system called Algonet, which incorporates this theory, the system is presently being deployed in the problem-based laboratory for this course that is taken by all computer science and engineering freshmen at Georgia Tech.

At the sophomore level, the development and implementation of interactive multi-media programs and databases in the introductory statics and mechanics of deformable bodies courses have added new dimensions to facilitate understanding and

insights into the material. Indeed, through the creation of a more simplified version, the program helps instruct K-12 students about science and technology. The program has been highly successful and well disseminated. The work is available to all Georgia Tech students over the local network and the more simplified versions have been distributed to over 3,500 schools. This work has been the result of collaborative efforts with faculty at VPI, and present work is to make it available to other Coalition schools, indeed nationally, through the WWW.

At the junior and senior levels, the concurrent engineering methodology for integration of engineering practice and design as demonstrated the value of better connections between theory and practice, the need for more horizon and vertical integration of engineering subjects, and illustrated the usefulness of TQM principles in concurrent engineering design. The course makes use of the Autonomous Unmanned Aerial Vehicle Competition to bring together faculty and students from several fields (e.g., AE, CS, ME, EE and Management) to design, build, test, integrate, and operate an Aerial Robotics Vehicle that is capable of autonomous design. Georgia Tech won the first competition, and continues to place high in the competition.

Finally, we have directed considerable effort to improving participation of women in engineering through the efforts of the Women's Engineering Board of **SUCCEED**. Initiated by Georgia Tech with participation from all **SUCCEED** campuses, the WEB has sought to network women faculty at all eight institutions. Through the network and their collaborative efforts, WEB has held several conferences and developed materials covering a range of issues ranging from academic success of women faculty, to the recruitment of undergraduate and graduate students into engineering, and to presently developing a Gender Equity/Teaching Excellence workshop at Georgia Tech.

While these are all valued contributions to the undergraduate engineering program, none is perhaps more gratifying to know that **SUCCEED** activity is having a positive affect on the tenure and promotion process. Several junior faculty that have contributed to **SUCCEED** have completed the tenure and promotion process. All have been tenured and promoted. Of course, while not everyone throughout the process agreed uniformly on the significance of the contributions provided by all the candidates, consideration of the educational innovation was thoughtful and the focus of the discussion was always on the degree of quality and impact of the work, both locally and nationally.

These are but some of the activities spawned by **SUCCEED** and whose success will be incorporated into the curriculum during the upcoming semester conversion. Having addressed a number of curriculum efforts, both with **SUCCEED** support and with support from other sources, we envision that these and other efforts can be fully institutionalized and sustained through the focused effort in four areas, as addressed below.

Envisioned Curriculum

The College of Engineering will implement a few strategic activities to deepen and broaden the impact of **SUCCEED** in the undergraduate engineering curriculum. Each activity involves elements of the four focus areas, thus, the effort will require close collaboration among the members of the Campus Implementation Team.

The progress of the first five years of **SUCCEED** in the development of educational technologies will be further integrated into the core science and engineering science curriculum at Georgia Tech. A primary purpose is to further integrate these key subjects and to better motivate and retain students in these early subjects. New classrooms being constructed will be configured to allow access to electronic media and information. Professors will be assisted in the basic uses of multimedia and how they can modify and add their own modules to the collection of programs.

Participation in the planning and implementation of high speed networks will ensure that all students will have full access to the courseware programs that have been developed. The semester conversion provides an opportunity to implement both multimedia and distance learning methods into the basic engineering courses. Efforts will be made to modify and extend existing multimedia courseware and to allow implementation and institutionalization of technology-based tools.

Building upon the multimedia expertise developed at Georgia Tech, efforts will be made to bring the technology to key high schools in the Atlanta region that are major suppliers of students to Georgia Tech. Potential Freshmen students will learn more about engineering and different majors within engineering through interesting engineering case studies located on the Web. The studies will be computer based so that animations, video, and simulations can be used in addition to the common text and graphics.

In years six through ten, Georgia Tech will institutionalize a faculty development program that is also well linked with existing educational centers on campus. We anticipate that the primary activities will include: training and development activities which demonstrate the effective use of technology and the appropriate authoring of educational activities within the learning environment; the incorporation of active and collaborative learning more broadly within our curriculum; the adoption and dissemination of faculty review programs to assess and enhance the value of educational innovations; and further adoption and awareness of gender and cultural issues in the education and professional activities of our faculty, staff, and students.

We envision using and creating **SUCCEED** computer resources which can be widely disseminated (e.g., the WWW) for building a community of faculty who share, augment, and create classroom learning activities, teaching pedagogy, and educational technology both in and out of the classroom. We expect that our efforts to date will be dramatically scaled-up so that a significant percentage of the faculty are involved with faculty development activities. The assessment of the performance of our students, along

with the assessment of the performance of our faculty, are a means to measure the successful impact of the faculty development programs.

Institute assessment has a good foundation at Georgia Tech. We have begun the process of generating outcomes at every level of the institution, from general education to specific department programs, along with some preliminary plans for their assessment. **SUCCEED**-supported efforts will focus on assessment of programs within the College of Engineering and be coordinated with ongoing Institute assessment in other domains, including general education, sciences, and the humanities. Assessment, done properly, is a complex set of ongoing tasks requiring not only considerable expertise, staff, organization, but long-term planning and coordination. Special emphasis will be placed on coordination with other **SUCCEED**-supported components as their goals necessarily interact with assessment. Enhancement of engineering education of women and minorities, faculty development, and technology-based instructional innovation all relate to outcomes and assessment of engineering programs. In sum, we see **SUCCEED** support as an essential component in a larger, coordinated program to assess undergraduate education at a high-quality engineering institution.

Our first efforts will be to establish a baseline of information related to the outcomes already generated here and suggested by the ABET criteria. Without such a baseline, we can neither evaluate the sorts of changes that will inevitably occur with a new semester curriculum, nor, perhaps more importantly, be able to design or modify that curriculum based on our assessment results. Particular emphases will be placed in the first two years on the development and testing of surveys to evaluate outcomes and other indices of the effectiveness of our engineering programs. While surveys do not encompass all essential aspects of assessment, they can, if properly designed and tested, be relatively cost-effective for the information obtained, and inform and support other dimensions of assessment. Other measures of program effectiveness will include a more formalized process of senior exit interviews. These interviews can provide significant information, but they must be systematized, and the information needs to be appropriately analyzed and acted upon. Finally, a third assessment procedure involves sampling and evaluation of senior student portfolios. Although it has many desirable features as samples of performance, the actual conduct of portfolio sampling and analysis is complex and resource demanding. We propose to explore development of effective and efficient means of portfolio evaluation. By year three, we would hope to be in a position to institutionalize these methods for program assessment in time for the our entry into semester curricula.

The philosophies that have driven the success of the Georgia Tech/OMED Challenge program served as guiding factors for **SUCCEED**'s Minority Retention Mega-Project for years one through five. Given the success of the effort, those same philosophies will now serve as the blueprint for the expansion and institutionalization of transition efforts for all students at Georgia Tech. Georgia Tech is committed to providing transitional services to this expanded student base, while still maintaining an

explicit focus on the need to continuously improve the performance and graduation of underrepresented students and women in engineering, science, and technology.

Transitions occur at various stages in a student's development with the transition from high school to university and from university to work as the more obvious. There are, however, other transitions that affect a students ability to persist successfully. We have identified the following as key transition areas for the implementation, expansion, and institutionalization phases of years six through ten: high school to university; calculus instruction to application of calculus (Physics, Statics, Dynamics); general curriculum to major specific curriculum; undergraduate to industry, graduate school, or graduate to teaching.

The OMED Challenge program will continue to exist as a primary vehicle for the successful academic transition of underrepresented students. More importantly, the program will expand its niche as a test bed for innovative attempts at enhancing curriculum and the delivery of conceptual understanding. It is envisioned that many of the efforts that involve transporting ideas and programs from other **SUCCEED** institutions can be piloted and refined through the summer transition programs.

During years one through five, **SUCCEED** sponsored efforts at Georgia Tech to develop a transition effort to service the unique needs of underrepresented students involved in transfer or 3/2 programs. **SUCCEED**'s support has allowed the program structure to evolve into an extensive pre-Georgia Tech interaction with the institutions and the prospective students, while maintaining the basic philosophies of successful transition gleaned from the Challenge experiences. Years six through ten will focus on fully implementing the pre-Georgia Tech interaction phase, expansion of the model to serve all students involved in transfer or 3/2 programs at Georgia Tech, and the transporting of the model to other institutions.

Calculus instruction to the application of calculus is an important transition because it is perhaps the first time that students have to extensively recall conceptual understanding from a previous course and apply it to another. Georgia Tech will make extensive use of the discriminate analysis process that has been applied to our basic physic courses to continue to refine the Precision Teaching methodology, auxiliary instruction and workshops, and the advising process for students entering the Physics portion of the curriculum. Georgia Tech will also expand current utilization of interactive multi-media tools in the statics, dynamics, and mechanics of deformable bodies courses and apply those tools to out of class workshops and instruction.

Data suggests that many students struggle with introductory courses for their particular major and many often change majors at least once, due to such early struggles. It is paramount that instruction to support this transition takes advantage of a student's different learning styles through the use of a wide array of multi-media tools and practical experiences. Georgia Tech will leverage **SUCCEED** support to engage industry and faculty in development of early practical design experiences for sophomores, utilizing

lessons learned from other focus teams and previous Coalition efforts. The experience will allow students to gain a deeper understanding of major areas and how the core curriculum applies to the real world.

NORTH CAROLINA STATE UNIVERSITY

Curriculum Prior to 1992

In the Fall of 1991 the College of Engineering included 10 academic departments which offered bachelor's, master's and doctoral degrees in disciplines including aerospace, biological and agricultural, chemical, civil, computer engineering, computer science, electrical, industrial, materials science and engineering, mechanical, nuclear, and textiles. Bachelor's degrees were given in construction, construction management, and furniture manufacturing. Graduate degrees were given in integrated manufacturing, engineering management, and operations research. The engineering undergraduate student enrollment was 6006 students, of which 18.5% were women, 9.5% were African-American, 0.9% Hispanic, 0.6% Native American, and 5.2% Asian American. In AY 1991-92, awarding 970 Bachelors, 295 Masters, and 97 Ph.D. degrees.

North Carolina State University admitted 75% of the College of Engineering undergraduate students during their freshmen year. The remaining 25% were transfer students, of whom about one-third were on-campus transfers and two-thirds were off-campus transfers. All freshmen students were admitted to the Engineering Undesignated program. Students were advised in their department of choice or, if undesignated, at the college level. Students were admitted to a department when they had satisfied the matriculation requirements. The only exposure to engineering in the first year was a one-credit course "Introduction to Engineering", which consisted of introductions to each discipline in a large lecture format.

The faculty size in the Fall of 1991 was 201, with most faculty actively engaged in research and graduate education. There were 10 women (2 full, 5 associate, 3 assistant) and 8 minority (1 full, 2 associate, 5 assistant) faculty. The primary faculty development program at the College level was a 2.5 day Teaching Effectiveness Workshop taught by Rich Felder, Ric Porter and Becky Leonard. Approximately 25 engineering faculty participated annually. Several other programs were available at the University level. The research expenditures in 1991-92 were $37M. The faculty reward system was typical of a major research university.

Prior to 1992 all programs in the College of Engineering were fully accredited. The program curricula were all equal to or less than the state mandated 128 credit hours (for four-year programs) including a 21 credit hour university-wide general education requirement. Some curricula included capstone design experiences, some of the students obtained practical training through participation in co-op or internships (~20% of the undergraduates participate in co-op), and the engineering curriculum could be broadly

characterized as science-based. The only formal multidisciplinary program was the Benjamin Franklin Scholars Program (a dual degree program between the Colleges of Engineering and Humanities and Social Sciences). The computational facilities were operated by a College of Engineering organization and primary student access to the UNIX-based system was at numerous central locations.

Current Curriculum

Several changes in degree programs have occurred. Bachelor's degrees are now being offered in environmental engineering. Furniture manufacturing has moved into industrial engineering and engineering management has moved into the College of Management. In an effort to reduce the student-faculty ratio, the College of Engineering made a conscious decision to reduce its student population. In the Fall of 1997 the undergraduate student enrollment is 5031, of which 19.9% are women, 10.5% are African-American, 1.9% are Hispanic, 0.6% are Native American and 6.9% are Asian. The College continues to enroll all freshmen to the Engineering Undesignated Program and has extensively enhanced its Freshman Engineering Program through **SUCCEED** support. In 1996-97 the College of Engineering awarded 946 Bachelors, 296 Masters, and 93 Ph.D.

The faculty size has increased slightly to 214 in the Fall of 1997. There were 14 women (1 emerita, 4 full, 4 associate, 5 assistant) and 8 minority (1 full, 3 associate, 4 assistant) faculty in tenured or tenure-track positions. The Teaching Effectiveness Workshop continues to be taught in the College to both faculty and teaching assistants. The Workshop is also now taught in other colleges on the NC State campus and across the country. More departments now have active faculty mentoring programs. In 1996 the State of North Carolina provided a special allocation for rewarding excellence in teaching. Approximately twenty-five percent of the engineering faculty received a minimum of $1000 added to their base salary in recognition of their teaching excellence. The research expenditures in 1996-97 were $53M.

Systemic curriculum renewal has begun at North Carolina State University, and **SUCCEED** is directly connected to much of this change. Considerable attention has been focused on the Freshmen Program. The College of Engineering has tested a variety of programs to successfully transition students into our large-population campus. The underlying theme among all these efforts is active and cooperative learning. During the Fall 1997, the College piloted a new Introduction to Engineering course to 275 of the incoming first year students. The new course integrates the aspects of Integrated Math-Physics-Engineering-Chemistry (IMPEC) (**SUCCEED**-funded), Product and Process Engineering (**SUCCEED**-funded), Engineering Skills and Design (**SUCCEED**-funded), and Freshman Engineering Rhetoric and Writing (**SUCCEED**-funded). Other programs include the minority student Summer Transition Program (STP) (partial funding from **SUCCEED**), Engineering Entrepreneurs (**SUCCEED**-funded), and Academic and Professional Preparation for Engineers (minority students) (no current **SUCCEED**

support) and a new mentoring program for women students which incorporates aspects of other mentoring programs in **SUCCEED**.

Efforts have not been confined to the Freshman Program. **SUCCEED** has also begun to have an impact on all aspects of the engineering curriculum. Considerable progress has been made in improving the design content of the curriculum. Two civil engineering courses have been modified to be more hands-on and design oriented. The engineering skills and design and the engineering entrepreneurs courses vertically integrate design. Every department now has a capstone senior design course. Cooperative and active learning oriented problem sessions have been incorporated into three electrical and computer engineering courses. Three material science courses have been enhanced with the use of CD-ROM and WWW technology to facilitate student learning. Information is easily shared from one institution to another over the WWW. A new multidisciplinary course on "Women and Gender in Science and Technology" is being jointly offered by the Division of Multidisciplinary Studies and the College of Engineering. Multidisciplinary design projects with students from the College of Design, College of Management, and the College of Engineering were sponsored by Glaxo-Wellcome during the Fall 1997 and Spring 1998. An interdisciplinary pilot project was initiated in Spring 1998 with students from Chemical Engineering, Electrical Engineering, and Computer Science. The project was provided by Wyeth-Lederle. Students from Electrical and Computer Engineering, Mechanical and Aerospace Engineering, Civil Engineering, and the School of Design teamed up to develop prototypes of a robot, lunar lander and habitat module. The team, HELIOS, took first place in the Space '98 Robotics Competition held in Albuquerque, NM on April 26-30, 1998. Instructional technology using the MBONE is enhancing the teaching/learning environment for on-campus and remote students participating in engineering courses.

The curricula of the various programs in the College of Engineering continue to evolve, with substantial change implemented during the past five years in the development of technology and our Freshman Programs. The impact of these efforts has been assessed through a Freshman Attitudes Survey, participation in a WEB-sponsored climate survey, an analysis of the 1995 and 1996 freshmen performance by demographics and academic preparation, and course/teaching evaluations done in all engineering courses.

Envisioned Curriculum

Our vision is to design a curriculum to produce graduates with the characteristics embodied in the mission of **SUCCEED** including critical and creative thinking; single-discipline and multi-disciplinary problem-solving skills; independent learning, teamwork, and leadership skills; communication skills, awareness and appreciation of cultural diversity; and motivation and aptitude for lifelong learning. The attributes of the curriculum will include active and cooperative learning-based instruction; horizontal and vertical integration of courses and curriculum content; systematic incorporation of engineering design and instructional technology throughout

the curriculum; and explicit development of critical success skills including communication, teamwork, time-management, and study skills.

The next and harder step is to scale up and institutionalize the application of instructional methods and materials that have been developed and implemented on a pilot scale in the first five years of **SUCCEED**. A cornerstone of the activities at North Carolina State University will be continued enhancement of the Freshman Program. To facilitate the curriculum revision at the upper division, a variety of faculty development activities will be used to equip them with techniques and the self-confidence they will need to make the approaches work, and to create a campus climate supportive of educational reform. In all of these activities, advanced computing and communication technology will be used to extend the reach and effectiveness of our engineering curriculum. Throughout the reform process, progress will continually be assessed and evaluated.

The College of Engineering at North Carolina State University is developing a strategic plan to guide the curriculum reform during the next five years. Attention will be given to addressing the challenges of scaling up the programs and to continue to provide a diversity of offerings so all of our engineering students can benefit. A significant component of the Successful Student Transitioning will focus on the First Year Program. We propose to expand the minority student Summer Transition Program (STP) to meet the needs of all first-year students and the minority student peer mentoring program (START) to include a component for women students. The new Introduction to Engineering course will be offered to all (~1100) incoming first-year students in Fall 1998. This new course will integrate components from Integrated Math-Physics-Engineering-Chemistry (IMPEC), a horizontally integrated approach to teaching the freshman courses; the Product and Process Engineering Laboratory, an introduction to products and processes through a hands-on, team learning and presentation approach; the Engineering Skills and Design, a vertically integrated course which teams upper division and lower division students on design teams; and the Special Topics - Freshman Engineering which integrates collaborative teaching strategies and group problem solving activities with the introduction to the COE computing environment.

Our efforts in Successful Student Transitioning will not be confined to the First Year Program. Departments are being encouraged to increase the number of multidisciplinary capstone design projects and to enhance their partnerships with industry to support these design activities. Industry will be encouraged to increase the number of co-op and internship opportunities for students and students will be encouraged to take advantage of these opportunities.

The College of Engineering will continue to extend its reach and effectiveness through the use of advanced computing and communication technology for local and remote course delivery and collaboration. We will continue to enhance our student-student and student-teacher communications using network-based collaborative environments for both on-campus and distance-based students. We will continue to

encourage the use of WWW technology to facilitate student learning. We propose to expand our distance-based course offerings to selected community colleges in the state.

Faculty development will be the principal vehicle for facilitating the widespread adoption of instructional materials and methods developed. The College of Engineering at North Carolina State University has long recognized the importance of providing faculty training in instructional approaches designed to enhance student learning. Approximately one-half of the engineering faculty have already participated in introductory-level teaching workshops. During Years 6-10, we propose to establish an Engineering Faculty Development Program and expand the offerings to include specialized workshops on critical topics including integration of writing and design throughout the curriculum, distance learning, effective use of instructional technology, dealing with diversity in the classroom.

UNIVERSITY OF FLORIDA

Curriculum Prior to 1992

In 1991 the College of Engineering included 12 academic departments which offered bachelor's, master's, and doctoral degrees in aerospace, agriculture, chemical, civil, coastal and oceanographic, computer and information science, computer engineering, electrical, engineering sciences, environmental, industrial, materials science and engineering, mechanical, nuclear, surveying and mapping, as well as interdisciplinary studies. The engineering undergraduate student enrollment was 2115 upper-division students, of which 16% were female, 13% African-American and 11% Hispanic.

The University of Florida was organized as an upper-division institution with students normally admitted to the College of Engineering at the junior level. Approximately half the students matriculated from on-campus lower division status and the other half from a network of 28 community college. The lower-division University of Florida students were advised outside the College of Engineering and were typically admitted to the College/discipline after 60 semester credit hours. The only exposure to engineering was the elective 1-credit course "Introduction to Engineering", which consisted of introductions to each discipline in a large lecture format. For community college students, an articulation agreement existed between the community colleges and the University of Florida. No approved engineering courses, however, were offered in the community college system. Students were admitted to the University after obtaining an Associates of Arts degree.

The faculty size in 1991 was 285 with most faculty actively engaged in research and graduate education. No organized faculty development program was operational at the College level, although limited programs were available at the University level. The faculty reward system was typical of a major research University, with the exception that the University of Florida is represented by a faculty state-wide Union.

The undergraduate curriculum was the rather standard ABET one with each program receiving full-term accreditation in 1989. The program curricula length ranged from 128 to 144 SCH with an average program length of 133 SCH. Required components included 22 SCH of General Education and 30 SCH of College of Engineering Core courses. The various curricula included standard capstone design experiences, little practice (6% co-op), and could be broadly characterized as engineering science-based. Very little evidence of cross-disciplinary education could be identified. The computational facilities were operated by a University-wide organization and the PC-based system was accessed by students at a few central locations.

Current Curriculum

The degree program offered by the College of Engineering remains the same with only slight name changes for five academic units. The engineering student body has grown to 3720 (Fall 96) students, of which 15% are women, 17% African-American, 14% Hispanic and <1% Native American. The University and the College are now in the process of instituting a freshman admission system that will shift advising responsibility to the College and permit the early introduction to engineering, although this latter component is not fully institutionalized. Approximately half the enrolled students still receive their first two year's education in the community college system. The University of Florida was mandated by the State of Florida to reduce all program lengths to 120 SCH. All College of Engineering programs was approved for 128 SCH with the exception of Civil and Chemical Engineering degree programs which were approved at the 131 and 134 SCH levels, respectively. This reduction in program length was achieved by reducing the General Education (by 3 SCH), College Core (by 2 SCH) and discipline specific (variable) requirements. The University of Florida has also taken a leadership role in seeking budget allocation independence, along with an increase in accountability. The increased accountability is now diffusing to the College level, but has had little impact at the program level.

The faculty size has grown to 300 and structured faculty development has improved at the University level, but it is not specific to engineering. A significant change has occurred in the academic climate amongst faculty. This has been driven by the large presence of **SUCCEED** in the College (e.g., faculty engaged in **SUCCEED** funded educational research, R. Felder's Teaching Effectiveness Workshop) and, importantly, by the University-wide Teaching Improvement Program. This program rewards faculty (adds $5,000 to base salary) for excellence in undergraduate education; sixty-six engineering faculty have received the award in the past three years. It is safe to state that a climate exists at the University of Florida for curriculum renewal with the onset of effective teaching accountability, a core of faculty leaders engaged in educational research, and a reward system in place to recognize teaching excellence.

Systemic curriculum renewal has begun at the University of Florida and **SUCCEED** is credited for much of this change. The College has tested multifaceted

programs to successfully transition both high school and community college students into our large-population campus. These programs are now impacting about 100 of the community college students per semester and 25% of the entering minority freshmen. We also are more engaged with outreach to pre-college students (SECME, engineering design manual, airplane design project) and community college students (active partnership with three community colleges, delivery of Statics at two, distance advising). Freshmen students now have more opportunity for early exposure to engineering. The course "Introduction to Engineering" has been changed from a lecture to a laboratory format and is fully institutionalized (no current **SUCCEED** support) and "Chemistry of Materials" co-taught by an engineering faculty) is an option for our students. **SUCCEED** is currently conducting an experiment to integrate Math, Physics, and Chemistry with engineering content.

SUCCEED driven change has also occurred at the discipline level. The College has instituted a two course sequence "Biology for Engineers" and modified the core requirements to permit programs to include the first course. A multidisciplinary immersion course "Process Engineering" (12 credits) has been taught during the last two summers and several programs have modified their degree requirements to permit credit substitution using this course. The College also has a fully institutionalized senior-level service course "Total Quality Management". Considerable progress has been made in improving the design content of the curriculum. An experimental vertically integrated design project in Aerospace Engineering has graduated its first students. The College has demonstrated a cost-effective approach to offering a multidisciplinary capstone design experience centered around industry driven and supported projects. This program is currently being scaled to 18 projects and 110 students. The College has also interfaced a data-base system to our on-campus utilities. This data-base system is providing, via the Internet, realistic process data and modules to several courses. An emulated flexible manufacturing laboratory has been developed and placed on the Internet and is now being used for the first time.

The curricula of the various programs in the College of Engineering are continuously evolving, with substantial change implemented during the past five years in the design area and with our interface with entering students. Two academic units (Civil Engineering and Industrial Systems Engineering) are currently engaged in the **SUCCEED**-facilitated curriculum renewal process.

Envisioned Curriculum

Our approach to developing an implementation methodology to achieve the goals of the **SUCCEED** Coalition at the University of Florida is influenced by various factors which presently impact on the undergraduate curriculum in the College of Engineering at the University of Florida. These include the following:

1. The overall college strategic plan for the undergraduate program is presently being given renewed attention, with a fairly broad charge and scope and the **SUCCEED** effort is an important subset of college-wide strategic plan. With the exception of one

member, the college-wide strategic planning group is made up of active **SUCCEED** personnel.

2. The SUCCEEED activities accomplished at the University of Florida in Years 1 –5 have already had a significant impact on key developments and innovations in the undergraduate curriculum. The current implementation and institutionalization phase of **SUCCEED** in years 6-10 provides an opportunity for substantial synergies overall college objectives and priorities. The activities of the **CIT** will be targeted first at meeting the specific **SUCCEED** objectives as mandated by the cooperative agreement while giving regard to the college directions.

3. The institutionalization of **SUCCEED** initiatives in achieving sustainable benefits of the **SUCCEED** program involves the College Curriculum Committee, as well as the support of the administration at the department level (chair, associate chairs and curriculum committee chairs, etc). In this latter regard we note that the College Curriculum Committee chairman is now a member of the **CIT** and that some 2/3 of the departments are already meaningfully active in **SUCCEED**-related projects. On the other hand, the present interest in meeting ABET 2000 requirements provide a favorable set of circumstances for advocating the implementation of the **SUCCEED** curriculum model which addresses many of these requirements. The college has established an ABET 2000 task force on which the **CIT** is represented. In addition each department in the college will appoint a **SUCCEED** liaison committee with one member in each of the four (4) **SUCCEED** focus areas.

4. The Institutionalization of **SUCCEED** innovations is already well underway at the University of Florida and this process is facilitated by the availability of some $600,000 per year in permanent state (matching) funds for **SUCCEED**. Our strategy in this regard is to use some of these funds to initiate implementation of high priority programs with a view towards making them progressively less dependent on **SUCCEED** NSF and matching funds, hopefully attaining some level of self-sufficiency. This should allow us enough resources to explore the importation of other **SUCCEED** or EEC innovations for deployment at the University of Florida.

5. The UF **CIT** also plans to exploit existing University-wide programs to provide immediate institutionalization of some **SUCCEED** innovations, targeted to the College of Engineering rather that to the University at large. In this way we will achieve sustainability and scalability of some of our programs without having to fund entire organizational structures to support these.

The **SUCCEED** curriculum model will form the focal point of the University of Florida's College of Engineering curriculum as appropriate elements of **SUCCEED**'s products and processes are implemented and institutionalized across the 12 academic departments. In addition to technical competency in the fundamentals of science and engineering practice, the engineering graduate of the 21st century must possess the

collateral attributes embodied in the key objectives of **SUCCEED**. To this end, the changes in the curriculum will be tailored towards imparting to our graduates the skills necessary to become creative team players and leaders with an appreciation for the global, social, and business context of engineering. At the same time, adherence to the highest ethical standards will be stressed.

The coincidence in timing of the initiative to shift advising responsibility of freshmen and sophomores to the College of Engineering along with the proposed college-wide implementation of **SUCCEED**'s curriculum model, provides a good opportunity to take this process of college-wide curriculum renewal to the very beginning of the process of producing graduates who must exhibit the model characteristics. As an added benefit, this timing virtually guarantees that institutionalization will occur.

Freshmen entering the University of Florida will be able to immediately participate in educational opportunities pioneered by **SUCCEED**. The Introduction to Engineering and the Biology for Engineers courses will be enhanced with additional laboratory exercises and demonstrations featuring active and collaborative learning techniques already tested by **SUCCEED**, with lectures and presentations contributed from all engineering departments. The **SUCCEED** Knowledge Studio program which features a project-based, just-in-time model for the integrated teaching of mathematics, science, and physics, will be refined and implemented for all incoming freshmen.

Our initial community college and high school outreach programs developed during Years 1-5 of **SUCCEED** will be integrated with existing pre-collegiate and transition programs in the College of Engineering, building on the institutional commitment and support structure to ensure sustainable implementation. Conventional advising and mentoring information will be facilitated by automated electronic bulletin boards, WWW pages, mailing lists, and news groups on the Internet as well as via a specially designed automated voice response system. In this way, frequently asked questions can be answered anonymously or by making direct contact with student, faculty or staff mentors. All of these transition programs will be coordinated with the Coalition-wide Transitions **CFT**.

During Years 6-10, all engineering programs at the University of Florida will conduct an outcomes assessment using the resources and advice of the Outcomes Assessment **CFT**. The **SUCCEED** curriculum renewal, which relies heavily upon outcomes assessment, has been led by the University of Florida, and two of our engineering departments will complete this process by the end of year 5. As part of the sustained institutional commitment and continuous curriculum refinement, all other departments will complete the process during Years 6-10, in preparation for the next ABET evaluation scheduled for the year 2000. The curriculum renewal process will facilitate the implementation of vertical intra-program integration as well as horizontal inter-program collaboration. Moreover, course structure and relevancy will be evaluated and redesigned to foster active and project or application based learning.

Course structure scrutiny will also provide the opportunity for cross-disciplinary synergisms both from the point of view of joint projects as well as in curricular integration. One scenario would be to have several departments collectively provide a course that would integrate various engineering disciplines. As one target in this respect, the mechanical, environmental and civil departments will develop a common course on the design of a water treatment plant. The civil students will be responsible for the structural design, the mechanicals for the pumps and appurtenances and the environmental students for the sizing of the retention tanks, trickling filters, etc. This experience will model realistic engineering assignments that the students may encounter upon graduation and will foster effective teamwork and an understanding the team concept which are essential components of a successful engineering firm.

As an ongoing process of curriculum reform, similar synergistic, multidisciplinary integration of courses will be implemented in both Control Systems and Computer Aided Drafting, as well as other subject areas that span several disciplines.

Outcomes assessment tools, methods and processes will also be implemented in conjunction with, and will expand upon, State mandated programs such as the Florida Quality Evaluation Project and the Performance-based Budgetary guidelines. Our new University of Florida engineering curriculum will promote awareness of engineering practice by increasing participation in industrial co-op and internship programs together with the expansion of the **SUCCEED** multidisciplinary Integrated Product and Process Design (IPPD) course that features projects defined and supported by industry. Additionally, the Emulated Flexible Manufacturing Laboratory will be expanded and offered across several program areas, and the **SUCCEED** International Program will also be adapted to the unique needs of the University of Florida in response to requests from several multinational industrial sponsors. Our overall goal is that 75% of all graduates in year 10 will have acquired some form of industrial experience.

In order to compliment this industrial experience, we will expand the scope our Technical Writing course currently required by all students. The enhanced version would add instruction and practice in both writing and effective speaking as well as in professionalism and ethics. Invited speakers would periodically present "real life" situations with the students debating the issues presented.

The key players in the delivery of engineering education is the faculty, approximately 15% of whom have been directly involved with the initial **SUCCEED** effort. An Engineering Faculty Development Center will be established at the University of Florida, in which the substantial accumulation of **SUCCEED** resources covering such topics as teaching effectiveness, technology usage, collaborative and active learning and self evaluation, will be made available to all engineering faculty. College approval will be sought to require all new engineering faculty members to participate in the training program offered by this center. The faculty development program will advocate a project-based, just-in-time and active teaching/learning philosophy coupled with the use of electronic and multimedia connectivity for collaborative interaction between students

and teachers. Many of the innovative ideas and teaching strategies developed and refined by **SUCCEED** can be implemented into existing courses with minimal effort by a reorganization of the material with a project or application based focus, coupled with the effective use of readily available multimedia and electronic communication tools. The University of Florida **SUCEED** Campus Implementation Team will operate college-wide subject area mailing lists, newsgroups, and WWW pages for all faculty who participate in the Faculty Development program. Training will be given to selected departmental representatives in setting up and managing such servers so that this effort can be transitioned to the academic departments.

The Faculty Development Center will be initially coordinated by the UF Campus Implementation Team, but will transition over the next 5 years to become the responsibility of the College's Office of Academic Programs to ensure institutional credibility and acceptance. Continuous assessment of the benefits of this effort will ensure its effectiveness and provide convincing support for its continuation beyond **SUCCEED**.

The use of technology-based tools for local and remote courseware delivery and collaboration will also be promoted within the College of Engineering as well as across the Coalition and beyond. Indeed, several new classrooms are presently being equipped for technology-based curriculum delivery. Selected instructional CD-ROM courseware modules from **SUCCEED** and other Coalitions will be adapted for use in several of our programs. The *Statics and Dynamics* modules, the *Visualizations in Materials Science CD-ROM* and *the Image Database Library* are some items which are of immediate interest, while others may be selected at a later time. The **SUCCEED** Faculty Development Center will seek advice and support from the Technology-Based Curriculum Delivery **CFT** on any required training for faculty interested in developing CD-ROM courseware.

A two-way video-conferencing and multiway audio-bridge facility will also be established in conjunction with the existing Florida Engineering Education Delivery System (FEEDS) and will be used to deliver Distance Education courses to Community Colleges and other Coalition schools, as well as for outreach and recruiting programs. These systems will also be used for **SUCCEED** Coalition meetings and for collaboration on projects across various institutions. This effort will be integrated with ongoing state and university-wide initiatives in distance education and asynchronous learning networks. Training in the use and development of electronic connectivity tools will be coordinated though the Faculty Development Center and in collaboration with the Technology-Based Curriculum Delivery **CFT**.

UNIVERSITY OF NORTH CAROLINA - CHARLOTTE

Curriculum Prior to 1992

In the mid 1980's the engineering curricula in the college of engineering at UNC Charlotte changed from interdisciplinary, applications-oriented titles (Urban-Environmental Engineering; Engineering Analysis and Design; Engineering Science, Mechanics and Materials) to more traditional titles and programs (Civil Engineering, Electrical Engineering, and Mechanical Engineering). Similarly, in 1987-88 the general MS in Engineering program was replaced by discipline-specific programs in Civil, Electrical, and Mechanical Engineering, except for those students wanting a more interdisciplinary program. Along with these changes came the addition of the Department of Computer Science to the college, making a total of five departments (three engineering, engineering technology with three programs, and computer science) with all the challenges, opportunities, and trials that such a heterogeneous set of programs engenders. The three engineering programs had a total of 45 full time faculty.

Although certainly influenced by the roots of the earlier interdisciplinary curricula, the disciplinary engineering programs were established as more traditional than evolutionary. Each of the programs required 132 credit hours for the degree, with a 35 hour math and science core, 24 hours in English and humanities/social science electives, 72 hours in technical courses, and a one-hour course in Freshman Engineering, covering professional development.

Although less than 50 years old, by 1991 the student enrollment of the entire university had grown to almost 11,000 (FTE) undergraduate and 1400 (FTE) graduate students. The College of Engineering had 133 undergraduates and 75 graduate students. Classified as a regional comprehensive university by the University System, UNC Charlotte offered an inter-institutional Ph.D. program in cooperation with NC State University, and a handful of Engineering students were in the pipeline at that time.

Current Curriculum

Only six years later, in the fall of 1997 the enrollment of the University has risen to approximately 13,500, of which the college of engineering has 1300 undergraduate and 300 graduate students (FTE). The college now offers Ph.D. degrees, in Electrical and Mechanical Engineering.

The College has implemented a new curriculum template for all programs, with:

a. 120-128 student credit hours (goal of 124)
b. inclusion of an integrated capstone experience.
c. flexibility to accommodate experiential and/or international learning
d. a traditional rather than our goal of an integrated engineering/math-science core, and

e. an opportunity to practice teamwork, some exposure to the issue of professional ethics, but little practice in management.

Also, the transition into the master's degree programs from our undergraduate programs has been simplified. As noted, considerable progress has been made on items a, b, and c above, but the adoption of an integrated engineering/math-science core and building practice in teamwork and management has enjoyed only modest progress. The following describes some (but not all) of the initiatives underway, several with the help of **SUCCEED**.

Strategic Planning. Beginning in the fall of 1994 the college undertook a new approach to strategic planning, one which utilized a radically new format, based on a college-wide shared Vision of its future and a new strategic planning process based on the principles and tools of TQM. Based on this Vision, we derived specific Goals in the process areas of student development, faculty development, and resource and community development. These goals were in turn evaluated in terms of the constraints or impediments to achieving them. This gave rise to identification of strategies, both bridging process areas and specific to each for accomplishing the goals. The strategies were then put into action plan format with specific, quantitative deliverables associated with each strategy and process area. The plan also contains a guarantee that the planning process will be true to its TQM principles, calling for the development of "An institutionalized planning process that enables us to continuously reaffirm our vision, reset our goals, re-examine our constraints, re-evaluate our strategies, and re-define our deliverables". Underlying this structure is the intention to tie strategic planning directly to outcome assessment, and to that end we established in the Spring of 1996 the Strategic Planning and Assessment Resources Team (SPART), which is coordinating strategic planning in the fall of 1996 and thereafter. SPART is facilitating the first Structured Biennial Reassessment (SBR) this fall, using the Strategic Plan produced in the Spring of 1995 as the starting point. This will be a two-day off-campus retreat, in which college leaders will review the current plan, the progress made toward each deliverable, and reassess the strategies in view of the threats and opportunities appearing on the horizon. SPART is providing a summary of data illuminating each deliverable, and an external facilitator. Following the college retreat, similar sessions, but one day in length, will be held for each department in the college, facilitated by a SPART faculty member or in one case an external facilitator sponsored by an departmental advisory committee member. We have already begun to put the existing plan on the World Wide Web for access and input by all stakeholders (students, alumni, employers, parents, and community partners). This is seen as a dynamic process of continuous revision, producing not a document so much as a continually unfolding plan that is responsive to all constituents.

Establishing a Comprehensive Database. Part of the work in tying strategic planning to outcomes assessment is "getting the numbers", and the college is establishing a comprehensive database on all aspects of each program in the college. SPART is coordinating this effort this fall to identify and begin tracking the needed data for each

deliverable in the strategic plan, many of which will be identified in the college and departmental SBR's.

Institutionalizing the Creative Projects Laboratory (CPL). The 1995 strategic plan called for establishment of an industry-supported student project laboratory by the fall of 1995. The CPL, funded by **SUCCEED** in the early stages, has grown from a partnership with IBM to a process which took its first steps at institutionalization in the fall of 1996 by the Office of Engineering Research and Industrial Development through recruiting of industry projects sponsors. The CPL has sponsored approximately 25 projects thus far after a low year in 1997-98, due to the retirement of the Industrial Liaison Officer. The CPL will be activated again in academic 1998-1998 with a goal of five multi-disciplinary project sponsors. The emphasis will remain in multi-disciplinary projects due to **SUCCEED** goals and ABET 2000.

Establishing a College-wide Mentoring/Advising System. A mentoring program was initiated in the fall of 1995 primarily in conjunction with the new freshman engineering courses which virtually all new students in the college are required to take. The Mentoring Program is fully operational and expanding. There is a full time director, with secretarial help and full-time assistance. Students have been incorporated into the mentoring program and it has widespread acceptance in the freshman and sophomore years. A computerized advising system was developed by a faculty member and is now available for use throughout the different departments.

Developing Innovative Freshman Engineering Courses. Beginning in the summer of 1995 the college embarked on an ambitious initiative to develop and offer (that Fall) a sequence of two courses for every engineering and computer science major entering the college. We have now offered ENGR 1201 and ENGR 1202 to one complete cohort of students (1995-96 freshmen), about 450 students, and we are beginning the second round. The goals of the courses are (a) to introduce the students to the college of engineering and to the profession and disciplines of engineering; (b) to introduce them to the college's computing resources and have them develop beginning proficiency in their use; (c) to afford the students early, successful experiences in two semester-long conceptual design projects, a multidisciplinary one in ENGR 1201 and one in their chosen discipline in ENGR 1202; (d) to have them develop and begin to practice skills in teamwork, creative problem solving, and habits of personal development; (e) to cultivate an appreciation of the value of diversity in thinking styles within oneself and among team members (using the HBDI, or Herrmann Brain Dominance Instrument) and (f) to begin to develop skills in technical presentations and technical report writing which will be enhanced in further coursework. An overarching goal is to set the stage for continued development of these skills, attitudes, and abilities in sophomore, junior, and senior years, which will require the active participation of departmental faculty in ENGR 1201/1202. Continued development and evolution of the course is in the hands of a five-person multidisciplinary team of faculty, including two members from the disciplinary departments on a three year rotation basis.

SUCCEED is being asked to fund evaluation of the implementation of this sequence through two graduate Industrial/Organization Psychology students to develop and administer evaluation instruments to students and faculty. Also, through use of the HBDI, we intend to determine the changes in preferences for thinking styles among students as they move through the curricula, particularly with respect to their abilities in creative thinking and analytical thinking, by administering the HBDI again upon graduation of the first cohorts of students taking ENGR 1201/1202.

Developing an International Option. The international option (a specific curriculum developed for students, with an international emphasis) was established three years ago and is growing in scope. There have been formal exchanges with institutions in Japan, France, Germany and the Netherlands. In the summer of 1998, a group of eight sophomores will go to Germany, with all expenses paid by the College of Engineering. Growing numbers of students are selecting the international option course package and we hope to involve students in the international Co-Op experience.

Promoting TQM in Coursework and Student Experiences. A new course ENGR 3670 Total Quality Systems has been approved by the faculty. Earlier versions of this course have been taught and improved with **SUCCEED** support during the last four years in connection with the Quality Improvement Partnerships (QIP) program of ten-week summer internships with participating industrial partners. Our goals during the implementation phase includes evaluation of the program from the perspective of the students in the TQS course and in the internships and of the faculty and industrial partners involved. The TQS course was evaluated by a group of Industry/Organizational Psychology graduate students in the fall of 1997 and the results of the evaluation should be available during academic year 1998-1999.

Envisioned Curriculum

Since strategic planning is a formal, ongoing task at this university, our goals and milestones are well set for the next few years. The actions initiated and described in the "Present State" section will be ongoing and will form the basis of our envisioned curriculum, with modifications as experience and constraints require. We certainly will have to cope with the scale-up challenges as the College and University grow. Our overall vision, "A collaborative and friendly learning environment in which all stakeholders (students, faculty, alumni, and community partners) are confident of their opportunity to succeed and are involved in the continuous measurement and improvement of the processes comprising our environment" will be the guide for our future curriculum.

SUCCEED is viewed as a facilitator and resource to the strategic planning process and for the attainment of our vision and goals. The focus areas of student transitions, faculty development, technology for curriculum delivery and outcomes assessment are directly in line with our formal planning outcomes. While the sum of the goals, strategies and deliverables stated in the strategic plan are too lengthy for inclusion, a few examples are worth mentioning.

In successful student transitions, we will strengthen the mentoring/advising program to include all students, and reach into the community college system, local colleges and public schools, utilizing computer technology. Our stated goals of retention/graduation rates of 70%, African-American graduation representation of 10%, and women graduation representation of 20% will require implementation of **SUCCEED** activities.

For faculty development activities we plan a faculty mentoring program for untenured faculty and implementation of faculty enhancement programs adopted from **SUCCEED**. Activities begun in recent years to assess and reward teaching will expand.

Technology-Based Curriculum Delivery figures large in the future plans for UNCC. We presently communicate with our students through a network based computer system and this system is being integrated into daily class-room activities. In the near future, advising will come on line and we envision the implementation of technology for community college and K-12 outreach. As the undergraduate programs become more oriented to teamwork and integration of materials, this is necessary to assist in transitions to, and from, the university. **SUCCEED** has been a leader in technology, and the experience and facilities of the Coalition will assist greatly in achieving our goals.

The outcomes assessment activities of **SUCCEED**, go hand-in-hand with our efforts to assess our changes and make appropriate corrections. The inclusion of this University in the **SUCCEED** database and our comparison with schools recognized nationally for excellence is a valuable benchmark. The curriculum restructuring activities of **SUCCEED** will be implemented in the near term and the TQ efforts and resources of the Coalition will assist and supplement out on-campus activities.

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Curriculum Prior to 1992

In 1991, the College of Engineering at Virginia Tech had 12 degree-granting programs at the B.S. level, a total undergraduate enrollment of 4,760 undergraduate students and 280 full-time faculty. We awarded 987 B.S. degree during 1991-92. Our graduate degrees were awarded in 15 programs at the M.S. and Ph.D. We awarded 399 M.S.'s and 121 Ph.D.'s during 1991-92. As the land grant university, Virginia Tech is the largest university in Virginia and enrolled a total of 23,365 students in the Fall, 1991. In 1991, the College of Engineering enrolled 912 women students and 171 African-American students.

In 1991, the College of Engineering had no office or director for women and minority programs. We had little multimedia training or effort among the faculty although we were beginning to build a multimedia laboratory. We had converted from

the quarter system to the semester system in 1987, but unfortunately, did not take full advantage of curriculum review and revision in that process. All 12 undergraduate B.S. degrees required 136 semester credits to graduate in 1991. Our senior design projects were traditionally taught within each department that required such projects.

Virginia Tech Engineering has proudly included Cooperative Education as a strong base for developing professional experience for undergraduates. In 1991, 15% of our students participated in the Coop Program with 400 employers around the country.

Beginning in 1985, the College began requiring all freshmen to have personal computers. We negotiate with vendors each year to provide the most powerful hardware and software system for the most reasonable price to incoming freshmen. Typically, the package was an IBM platform and the price was in the $2,000 range in 1991.

Current Curriculum

Today, we continue to offer degree programs in 12 undergraduate disciplines. A few departments have changed their names: Agricultural Engineering became Biological Systems Engineering; Industrial Engineering and Operations Research became Industrial and Systems Engineering. All degrees still require 136 semester credits to graduate.

In the fall of 1996, we enrolled 950 engineering freshmen. Our total undergraduate enrollment is 4,500 students. The number of women enrolled is 856 and African-Americans is 185. The College graduated 925 B.S.'s., 454 M.S.'s and 105 Ph.D.'s in 1995.

In 1992, the College of Engineering hired a Director for Women and Minority Programs. Dr. Bevlee Watford directs the efforts of that office and we now have a retention rate to graduation among minorities that equals the overall retention rate — 70% from the freshmen year to B.S. graduation within 5 years. Mentoring programs, tutoring programs, and professional skills classes are just a few of the programs offered to women and minorities. While our numbers of women and minorities enrolled have not changed substantially since 1991, our retention rate has increased dramatically. The number of women and minority faculty in engineering is now 14 and 5, respectively — still small but growing.

We have an extensive multimedia laboratory, and many faculty and all students have multimedia computers on their desks. The university conducts annual faculty development courses in computer literacy and many faculty now use list servers in communicating with their classes as well as posting notes on their individual faculty web pages. All faculty and students have email addresses. The President, Vice Presidents, and Deans communicate to faculty on email. Instructional technology allows us to have collaborative courses with engineering schools in France, Italy, and Germany.

Because of our efforts in **SUCCEED**, the College of Engineering is reviewing our engineering core curriculum and the number of credits for graduation. We are reviewing our math and science requirements. We are beginning to cross list more courses both internal and external to the College of Engineering. We have instituted a "Writing Across the Curriculum" program which was piloted in Materials Science Engineering and is now being implemented in other engineering departments. This team teaching with English and Engineering faculty has greatly enhanced the quantity and quality of written work our students complete as undergraduates.

In design classes, we have piloted vertical and horizontal integration of design courses. With **SUCCEED** funding, we began a program of placing freshmen in senior design courses. We also instituted multidisciplinary design projects for mechanical, aerospace, and industrial engineers. Today, we are organizing "virtual corporations" which will include students, faculty, and staff from all levels and disciplines working on complex design projects relevant to the needs of business and industry. In fact, the projects and some of the funding for these new, team-taught, team environment courses comes from business and industry.

There is an awareness and new appreciation for assessment and evaluation of the educational process. While Virginia Tech has always used student generated teaching evaluations, we have a new Office of Assessment which conducts outcomes assessment with alumni and industry.

The College of Engineering has also established a faculty chair: The W. S. White Chair for Innovation in Engineering Education. The first recipient of that chair is Charles Reinholtz, a **SUCCEED** PI working on horizontally-integrated design projects in Mechanical, Electrical, and Industrial and Systems Engineering. This position is in recognition of teaching excellence and serves as a leader in the curriculum innovation and renewal process.

Today, approximately 7% of our students participate in a study or travel abroad project, while 20% of our students have coursework experience in international topics. The Co-op program attracts 18% of our engineering students.

Envisioned Curriculum

The College of Engineering envisions a curriculum that incorporates **SUCCEED**'s curriculum model components: content integration, engineering practice, student mentoring, faculty recognition, early design, and electronic delivery. We plan to increase the number of students involved in multidisciplinary design projects beginning in the freshmen year to accommodate all of the freshmen. The goal is to have at least 20% of our students with an international study or travel program before graduation. We want to increase the number of students involved in cooperative education as well as increase the number of students involved in virtual corporation design projects. Balancing theory with practice is an essential component of our curriculum model.

Our curriculum renewal process is also attempting to reduce the number of credits to graduate at the B.S. level while incorporating the professional practice skills required for success in industry. Each degree program is in the process of deciding the number of credits required; they may vary from program to program for the first time in our history. Each faculty is reviewing the freshman and sophomore core requirements to determine whether our present requirements are suitable for today's technological environment. We are reviewing overlapping and redundant course offerings. For example, we have offered 9 different undergraduate courses in fluid dynamics. Through, collaboration and team teaching, we think we can reduce that number significantly, thereby freeing resources for innovations in our curricula.

While we continue to require personal computers, our goal is to graduate students who are experienced yet flexible in their approach to using computers to solve problems. Because Blacksburg is an electronic village and all engineering students and faculty have computers, we have several projects underway to investigate distance learning and using instructional technology to enrich our course content.

Accomplishments during the academic year 97-98 demonstrate that we are engaged in the process of systemic reform of undergraduate engineering education. Here are some examples: Peer mentoring was provided for approximately 300 underrepresented freshman; a summer bridge program was held for Black pre-engineering students (30 participants); curriculum renewal based on the **SUCCEED** model was completed in Mechanical Engineering and initiated in the Engineering Freshman Program; pilot courses with elements of the **SUCCEED** curriculum were developed and taught; most involved cooperative activities of multidisciplinary, vertically integrated, student teams; specific examples include: integrated engineering experiences in engineering calculus, virtual corporations, hands-on statics lab, integrated building design, infrastructure rehabilitation design, hands-on freshman lab experiences and connections to engineering practice, and multimedia statics. Several of these courses had industrial involvement and support. In addition, workplace transition workshops were held for freshmen, transfer students, women, and seniors, and teaching and advising workshops were presented for the faculty.

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